U.S. Fish & Wildlife Service

Abundance and Run Timing of Adult Pacific Salmon in the Tuluksak River, Yukon Delta National Wildlife Refuge, Alaska, 2005

Alaska Fisheries Data Series Number 2006–8

Kenai Fish and Wildlife Field Office
Kenai, Alaska
April 2006

The Alaska Region Fisheries Program of the U.S. Fish and Wildlife Service conducts fisheries monitoring and population assessment studies throughout many areas of Alaska. Dedicated professional staff located in Anchorage, Juneau, Fairbanks, Kenai, and King Salmon Fish and Wildlife Offices and the Anchorage Conservation Genetics Laboratory serve as the core of the Program's fisheries management study efforts. Administrative and technical support is provided by staff in the Anchorage Regional Office. Our program works closely with the Alaska Department of Fish and Game and other partners to conserve and restore Alaska's fish populations and aquatic habitats. Additional information about the Fisheries Program and work conducted by our field offices can be obtained at:

http://alaska.fws.gov/fisheries/index.htm

The Alaska Region Fisheries Program reports its study findings through two regional publication series. The **Alaska Fisheries Data Series** was established to provide timely dissemination of data to local managers and for inclusion in agency databases. The **Alaska Fisheries Technical Reports** publishes scientific findings from single and multi-year studies that have undergone more extensive peer review and statistical testing. Additionally, some study results are published in a variety of professional fisheries journals.

Alaska Fisheries Data Series Number 2006-8, April 2006
U.S. Fish and Wildlife Service

Abundance and Run Timing of Adult Pacific Salmon in the Tuluksak River, Yukon Delta National Wildlife Refuge, Alaska, 2005

Laura M. Zabkar, Frank Harris, and Ken C. Harper

Abstract

A resistance board weir was used to collect abundance, run timing, and biological data from salmon returning to the Tuluksak River, a tributary to the lower Kuskokwim River, between June 24 and September 9, 2005. Data collected were used in-season to manage the commercial and subsistence fisheries in the Kuskokwim area. A total of 35,696 chum *Oncorhynchus keta*, 2,653 Chinook *O. tshawytscha*, 642 sockeye *O. nerka*, 2,475 pink *O. gorbuscha* and 11,324 coho salmon *O. kisutch* were counted through the weir during 2005. Peak weekly passage occurred July 3 to 9 for Chinook, July 10 to 16 for chum and sockeye salmon, July 17 to 23 for pink salmon, and August 21 to 27 for coho salmon.

Introduction

The Tuluksak River, located approximately 222 river kilometers (rkm) upstream from the mouth of the Kuskokwim River, Alaska, (Whitmore et al. 2005) flows through the Yukon Delta National Wildlife Refuge (Refuge) and supports spawning populations of chum, Chinook, pink, coho, and a small population of sockeye salmon. These salmon contribute to large subsistence and commercial fisheries in the lower Kuskokwim River drainage. In addition to human consumption, salmon provide food for brown bears and other carnivores, raptors and scavengers. These salmon also sustain resident fish species and salmon fry that rely heavily on the nutrient base provided by salmon carcasses (U.S. Fish and Wildlife Service 1992).

Under guidelines established in the sustainable salmon fisheries policy 5AAC.39.222, the Alaska Board of Fisheries designated Kuskokwim River chum and Chinook salmon as yield concerns. This designation was based upon the continued inability, despite specific management measures, to maintain expected yields, or have stable surplus above the stock's escapement needs for three of the past five years. Based upon this designation, the salmon fishery in the Kuskokwim River drainage has been managed under the Kuskokwim River Salmon Rebuilding Management Plan for the past four years (Rebuilding Plan) (5AAC 07.365; Ward et al. 2003; Bergstrom and Whitmore 2004). The portion of the Kuskokwim River within the boundaries of the Refuge was under both the Rebuilding Plan and the Federal Subsistence Fishery Management program.

The Alaska Department of Fish and Game (Department), the U.S. Fish and Wildlife Service (Service), and the Kuskokwim River Salmon Management Working Group (Working Group) work together to achieve the goals of both The Rebuilding Plan and the Federal Subsistence Fishery Management program. The Rebuilding Plan was established to provide management guidelines resulting in the sustained yield of salmon stocks large enough to meet the following goals: (1) To manage for the achievement of established escapement goals; (2) To meet the amounts necessary for subsistence; and (3) To allow for a commercial fishery on harvestable surplus after escapement and subsistence needs are projected to be met (Ward et al. 2003). In addition to the goals set by the Department, the Service, and the Working Group, the Alaska

Authors: Laura M. Zabkar and Ken C. Harper are fisheries biologists, and Frank Harris is a biological science technician with the U.S. Fish and Wildlife Service. The authors can be contacted at Kenai Fish and Wildlife Field Office, PO Box 1670, Kenai, Alaska 99611; or Ken_Harper@fws.gov or Frank_Harris@fws.gov.

National Interest Lands Conservation Act (ANILCA) mandates that salmon populations and their habitats be conserved in their natural diversity within the Refuge.

To manage for sustained yields and conservation of individual salmon stocks, managers need escapement data and migratory timing of individual stocks accompanied by sex and age composition throughout the migratory period. Managing for individual salmon stocks can be difficult since salmon stocks are mixed during the annual migration up the Kuskokwim River, increasing the potential for smaller salmon stocks to be over harvested during periods of commercial and subsistence fishing. Therefore, state and federal managers attempt to conserve these smaller salmon stocks by distributing harvest throughout the entire salmon run.

In previous years, salmon escapements were monitored using aerial index surveys and a resistance board weir in the Tuluksak River. Aerial index surveys started in 1965 and occurred sporadically until 1997 (Harper 1997; Ward et al. 2003). These surveys however, were infrequently used for in-season management of the Kuskokwim River fisheries because the surveys often occurred after the commercial and subsistence fishing seasons.

In order to obtain salmon escapement data, a resistance board weir was used in the Tuluksak River between 1991 and 1994, and between 2001 and 2005. A weir was not operated on the Tuluksak River between 1995 and 2000.

In 2004, the Tuluksak River escapement monitoring project transitioned from a cooperative agreement to a contract between the Service and the Village of Tuluksak. This contract has continued to meet the goals of the Service, Department, Working Group and the mandates of ANILCA. No change has been implemented to the following project objectives: (1) count the daily passage of chum, Chinook, sockeye, pink, and coho salmon and resident fish species through a weir on the Tuluksak River; (2) describe run-timing using daily passage counts of chum, Chinook, sockeye, pink, and coho salmon passing through the weir; (3) estimate weekly age and sex composition of chum, Chinook, and coho salmon passing through the weir; (4) determine the length of chum, Chinook, and coho salmon by age and sex; (5) enumerate chum, Chinook, sockeye, pink, and coho salmon carcasses washing onto the weir each day. These data will aid the in-season management of the Kuskokwim River subsistence and commercial fisheries; and setting biological escapement goals to maintain the sustainability of salmon resources.

Study Area

The Tuluksak River is one of several tributaries flowing into the lower Kuskokwim River and is located approximately 116 rkm northeast of Bethel, AK (Whitmore et al. 2005). The Tuluksak River is approximately 137 rkm in length and its watershed encompasses approximately 2,098 km^2 (Harper 1997) (Figure 1). It originates in the Kilbuck Mountains and flows to the northwest. The Fog River drains into the lower portion of the Tuluksak River and is the only major tributary. The Tuluksak River is a slow moving river for the majority of its length and is characterized by dense overhanging vegetation and cut banks. The lower portion of the river is characterized by low-gradient, silty substrate and turbid waters.

The river section at the weir site, approximately 49 rkm from the mouth, is 42 meters wide, shallowest in mid-river and deepest near the banks. The substrate contains primarily sand mixed with fine gravel. Water clarity is moderately clear but can become turbid during rainy periods and when boat traffic is present.

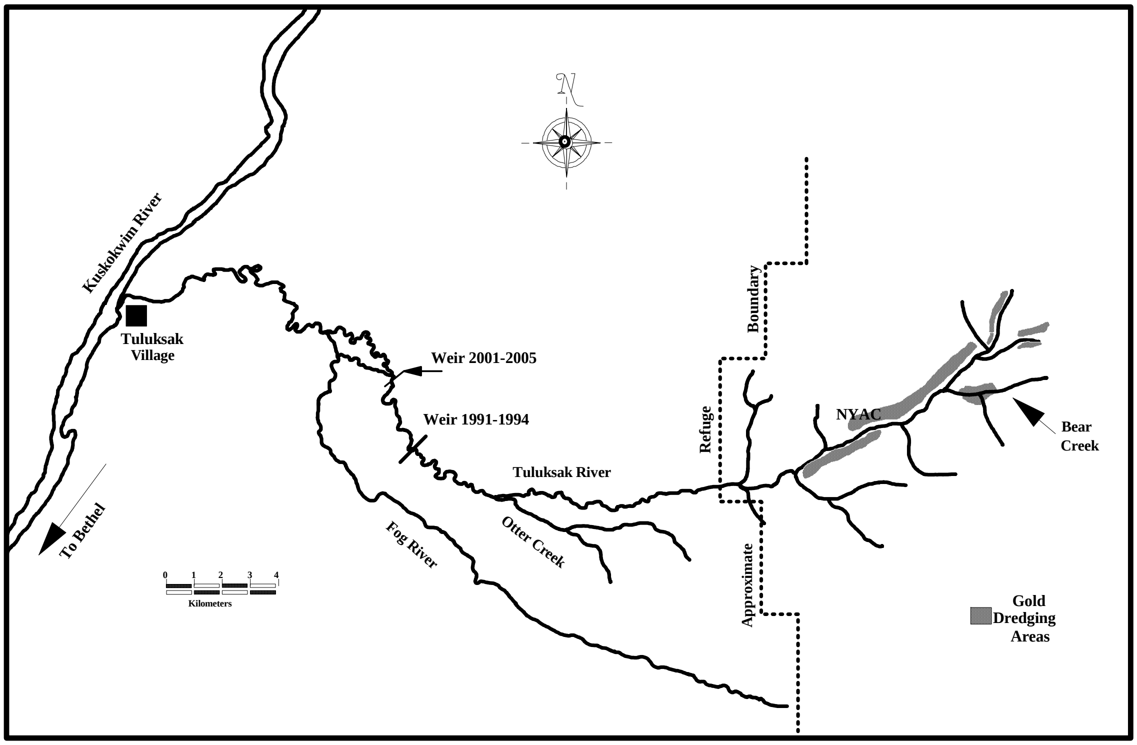


FIGURE 1.—Tuluksak River weir location, Yukon Delta National Wildlife Refuge, Alaska, 1991-1994, and 2001-2005.

Methods

Weir Operations

A resistance board weir (Tobin 1994) was installed in 2005 in the Tuluksak River at rkm 49 (61°02.641') (W160°35.049'). This location is approximately 16 rkm downstream from the weir site used between 1991 and 1994 (Harper 1995a, 1995b, 1995c; 1997). The new weir was relocated to a position down stream of known salmon spawning areas. The lower site also provides easier boat access to the weir and camp site during low water conditions.

This weir was modified slightly from the previous weir design used between 1991 and 1994 (Tobin 1994). A range of modifications took place in 2001 to increase efficiency of installation, operations, and takeout, and increase the efficiency of fish passage (Gates and Harper 2002).

Two passage panels were installed; one with an attached live trap. Counts started at approximately 0700 hours every day and continued until visibility was too poor to identify salmon by species. All passing salmon and resident fish were identified to species and recorded.

A stream gauge was installed near the shore on the river right bank approximately 10 meters downstream of the weir. The stream gauge (cm) was read twice daily and noted in the field log. To compensate for the placement of the stream gauge and to have it more accurately reflect the water depth across the river, an average water depth and stream gauge reading were taken simultaneously post installation. Water temperatures were recorded using an ONSET, Optic StowAway ®Temp logger. The temperature logger was programmed to record a temperature reading every 30 minutes and was placed in a location not affected by daily fluctuations of surface temperatures. The Temp logger was downloaded once at the end of the season. Temperature data were then averaged for each day.

Biological Data

Statistical weeks started on a Sunday and continued through the following Saturday (Harper 1997). Target sample size consisted of 210 chum and Chinook salmon each week. The coho salmon sample was obtained at three different time periods during the run and consisted of 210 fish per sample when possible. Biological sampling occurred between Monday and Thursday of each statistical week in order to obtain a snapshot sample (Geiger et al. 1990). Once the quota was met for a particular species, sampling would stop for that species and continue for others but typically would not extend past Thursday.

Age, sex, and length data were collected from each sampled salmon. Sampled fish were caught using the live trap attached to the passage chute. A fyke gate, installed on the entrance of the trap, allowed fish to enter and at the same time minimized the number of fish exiting the trap downstream. Sampling occurred when approximately 40 fish were in the trap. Four scales were extracted from Chinook and coho salmon and one was extracted from chum salmon for age determination. All scales were taken from the preferred area using methods described by Koo (1962) and Mosher (1968). Sex was determined by observing external characteristics, and length was measured to the nearest 5 millimeters from the mid-eye to the fork of the caudal fin. All data was recorded and then transferred to mark-sense forms at the end of each sample day. Mark-sense forms were processed by the Department when their personnel completed aging of the scales.

Fin tissue samples were collected in 2005 from a sample of adult Chinook salmon in the Tuluksak River to confirm phenotypic sexes by genetic markers from fin clips. Chinook salmon smaller than 700 mm, and identified phenotypically as females were tested genetically to confirm sex (Olsen et al, 2004; Metcalf and Gemmel, 2006). Fin tissue samples were placed in a 2 ml vial with 90% ethanol. Genomic DNA was isolated from the fin tissue using the protocol of Nagler *et al.* (2004). Genetic sex was determined using a genetic sex marker for Chinook salmon, *OtY1* (Devlin et al, 1991). The laboratory analysis followed the methods of Chowen and Nagler (2004) and were conducted by James Nagler at the University of Idaho

Salmon ages were reported according to the European Method (Koo 1962) where numerals preceding the decimal denote freshwater annuli and numerals following the decimal denote marine annuli. Total years of life at maturity is determined by adding one year to the sum of the two digits on either side of the decimal (i.e. age 1.4 and 2.3 (1.4=1+4+1=6 and 2.3=2+3+1=6) are both six-year-old fish from the same parent year). The parent year is determined by subtracting fish age from the current year.

Characteristics of fish passing through the weir were estimated using standard stratified random sampling estimators (Cochran 1977). Within a given stratum m, the proportion of species i passing the weir that are of sex j and age k (pijkm) was estimated as

$$\hat{p}_{ijkm} = \frac{n_{ijkm}}{n_{i++m}},$$

where n_{ijkm} denotes the number of fish of species i, sex j, and age k sampled during stratum m and a subscript of "+" represents summation over all possible values of the corresponding variable, e.g., n_{i++m} denotes the total number of fish of species i sampled in stratum m. The variance of $\hat{p}_{ijkm}$ was estimated as

$$\hat{v}\left(\hat{p}_{ijkm}\right) = \left(1 - \frac{n_{i++m}}{N_{i++m}}\right)\frac{\hat{p}_{ijkm}\left(1 - \hat{p}_{ijkm}\right)}{n_{i++m} - 1},$$

where N_{i++m} denotes the total number of species i fish passing the weir in stratum m. The estimated number of fish of species i, sex j, age k passing the weir in stratum m (N_{ijkm}) is

$$\hat{N}_{ijkm} = N_{i++m}\,\hat{p}_{ijkm},$$

with estimated variance

$$\hat{v}\left(\hat{N}_{ijkm}\right) = N_{i++m}^{2}\,\hat{v}\left(\hat{p}_{ijkm}\right).$$

Estimates of proportions for the entire period of weir operation were computed as weighted sums of the stratum estimates, i.e.,

$$\hat{p}_{ijk} = \sum_{m}\left(\frac{N_{i++m}}{N_{i+++}}\right)\hat{p}_{ijkm}$$

with estimated variance

$$\hat{v}\left(\hat{p}_{ijk}\right) = \sum_{m}\left(\frac{N_{i++m}}{N_{i+++}}\right)^{2}\hat{v}\left(\hat{p}_{ijkm}\right).$$

The total number of fish in a species, sex, and age category passing the weir during the entire period of operation was estimated as

$$\hat{N}_{ijk} = \sum_{m}\hat{N}_{ijkm},$$

with estimated variance

$$\hat{v}\left(\hat{N}_{ijk}\right) = \sum_{m}\hat{v}\left(\hat{N}_{ijkm}\right).$$

If the length of the r^{th} fish of species i, sex j, and age k sampled in stratum m is denoted x_{ijkmr}, the mean length of all such fish (μ_{ijkm}) was estimated as

$$\hat{\mu}_{ijkm} = \left(\frac{1}{n_{ijkm}}\right)\sum_r x_{ijkmr},$$

with corresponding variance estimator

$$\hat{v}(\hat{\mu}_{ijkm}) = \left(1 - \frac{n_{ijkm}}{\hat{N}_{ijkm}}\right)\frac{\sum_r (x_{ijkmr} - \hat{\mu}_{ijkm})^2}{n_{ijkm}(n_{ijkm} - 1)}$$

The mean length of all fish of species i, sex j, and age k (μ_{ijk}) was estimated as a weighted sum of the stratum means, i.e.,

$$\hat{\mu}_{ijk} = \sum_m \left(\frac{\hat{N}_{ijkm}}{\hat{N}_{ijk}}\right)\hat{\mu}_{ijkm}$$

An approximate estimator of the variance of $\hat{\mu}_{ijk}$ was obtained using the delta method (Seber 1982),

$$\hat{v}(\hat{\mu}_{ijk}) = \sum_m \left\{ \hat{v}(\hat{N}_{ijkm}) \left[\frac{\hat{\mu}_{ijkm}}{\sum_x \hat{N}_{ijkx}} - \sum_y \frac{\hat{N}_{ijky}\,\hat{\mu}_{ijky}}{\left(\sum_x \hat{N}_{ijkx}\right)^2} \right]^2 + \left(\frac{\hat{N}_{ijkm}}{\sum_x \hat{N}_{ijkx}}\right)^2 \hat{v}(\hat{\mu}_{ijkm}) \right\}$$

A chi-square test of independence (Agresti 1990) was used to test the hypothesis of independence of sex and age, by species. Because a fundamental assumption of the test is that the data are derived from a single random sample, the test was modified to accommodate a stratified random sampling design. Using the first order approximation of Rao and Thomas (1989), the usual test statistic was divided by the mean generalized design effect. A significance level of $\alpha = 0.05$ was used.

A two-sample t-test $\alpha = 0.05$ (Systat 8.0) was used to test the hypothesis that male and female fish of age k have equal mean lengths. Data were pooled across all strata and treated as one sample to compare lengths.

Results

Weir Operations

The weir was installed on June 24, 2005, and operated through September 9, 2005. During installation, the rail was reset to compensate for substrate change that occurred over winter and spring break-up. The weir was installed in the same location as 2004. Minor repairs were made to damaged weir components during the 2005 field season.

Average water depth during 2005 was 48 cm. Maximum water depth of 140 cm occurred on September 1 and a minimum depth of 20 cm occurred mid-August (Appendix 1). Water temperatures averaged 14°C, and ranged from 10°C on June 24 to 17°C on July 12 (Appendix 1).

Biological Data

Chum Salmon—A total of 35,696 chum salmon, passed through the weir from June 27 to September 9. One hundred and fifty-six of the chum salmon passing the weir, (<1%) were observed with gill net marks. Peak weekly passage (N=10,539), representing 30% of the escapement, occurred between July 10 and July 16 (Figure 2). The observed median cumulative passage date occurred on July 19 (Appendix 2).

Four age groups were identified from 1,147 chum salmon sampled from the weir escapement. Female chum salmon comprised less than 50% of the weekly passage through the majority of the run and 39% of the escapement (Figure 3, Appendix 3). Age 0.3 chum salmon were the most abundant, accounting for 93% of the aged sample (Appendix 3). There was a significant difference in age composition between sexes ($P<0.01$).

Lengths of age 0.3 chum salmon ranged from 435 to 695 mm (Appendix 4). In sampled fish, the mean length of males was greater than that of same-aged females for fish ages 0.3, (two-tailed t test: age 0.3, $t=13.579$, $df=1047$, $P<0.01$). Mean lengths of age 0.2 and 0.4 did not differ (two-tailed t test: age 0.2, $t=0.757$, $df=50$, $P=0.453$; age 0.4, $t=2.351$, $df=38$, $P=0.024$).

Chum salmon carcasses were first recorded on June 27, 2005. Median cumulative passage dates for escaping chum salmon and chum salmon carcasses washing onto the weir were separated by 14 days (Figure 4). A total of 3,222 chum salmon carcasses passed downstream over the weir from June 27 to September 9.

Chinook Salmon—Chinook salmon (N=2,653) passed through the weir between June 26 and September 2. Thirty-four of the Chinook salmon passing the weir, (1%) were observed with gill net marks. Peak weekly passage occurred between July 3 and July 9 (N=1,365) (Figure 2). The median cumulative passage date occurred on July 9 (Appendix 2).

Four age groups were identified from 439 Chinook salmon sampled between June 27 and August 9, 2005 (Appendix 5). Female Chinook salmon comprised less than 30% of the weekly passage through the first half of the run, and composed an estimated 35% of the total escapement (Figure 3, Appendix 5). Age 1.3 and 1.4 dominated the Chinook salmon escapement by 33%, and 35%, and age 1.2 accounted for 31% (Appendix 5). Age 1.5 was present in the 2005 sample. Age composition differed between sexes ($X2(\delta.)=151.8$, $df=3$, $P<0.01$). Males were primarily age 1.2 (28%), and females were predominantly age 1.4 (24%) (Appendix 5).

Fifteen Chinook salmon phenotypically identified as females (external characteristics) during the first sampling strata were examined using the genetic sex marker *OtY1*. Lengths of sampled fish in mm (MEFL) were; 450, 595, 575, 565, 530, 500, 660, 590, 680, 565, 575, 660, 605, 695, 555. All fifteen samples were identified as genetic males. Therefore, all fish less than 700 mm that were originally classified as females were reclassified as males to reflect the genotypic identification. Classification of sampled fish was changed from females to males for the following ages; 16 age 1.2, 8 age 1.3, and 1 age 1.4. Estimates of run composition by sex and age by strata were then calculated (Appendix 5). Females comprised 35% of the return, increasing from 7% in the first sample strata to 28% during week two, the peak escapement week, when 1,365 Chinook salmon passed. Females comprised 40% by the third week when escapement decreased.

Lengths at age for 1.3 and 1.4 Chinook salmon ranged from 500 to 1,020 mm (Appendix 6). Mean lengths of age 1.3 and age 1.4 females was greater than that of same-aged males (two-tailed t test: age 1.3, $t=10.038$, $df=141$, $P<0.01$; age 1.4, $t=4.776$, $df=145$, $P<0.01$) (Appendix 6). Insufficient samples were available for comparison of age 1.2 and 1.5.

Chinook salmon carcasses (N=98) were observed on the weir starting July 7, 2005. This was approximately eleven days after the first Chinook salmon was counted through the weir. The median cumulative passage dates for daily escapement and carcasses were separated by 25 days (Figure 4).

Sockeye Salmon—Sockeye salmon (N=642) passed the weir between June 27 and September 7, 2005. Four of the sockeye salmon passing the weir, (<1%) were observed with gill net marks. Peak weekly passage occurred between July 10 and 16 (N=224) (Figure 2), with a median cumulative passage date of July 18 (Appendix 2).

Thirty-two sockeye salmon carcasses were counted on the upstream side of the weir during 2005. The first carcass washed onto the weir on August 2, thirty-six days after the first sockeye salmon was counted through the weir.

Pink Salmon—Pink salmon (N=2,475) started to pass the weir on June 29 and periodically passed in small numbers until September 4, 2005. Peak weekly passage was observed between July 17 and 23 (N=1,075) (Figure 2). The median cumulative passage date was July 20 (Appendix 2).

The first pink salmon carcass washed onto the weir on July 20, twenty days after the first pink salmon was counted through the weir. The median cumulative passage date for pink salmon carcasses was August 6. One hundred and eighty-four pink salmon carcasses were counted on the weir during operations, which accounted for 37% of the pink salmon counted through the weir. The median cumulative passage dates for daily escapement and carcasses were separated by 10 days.

Coho Salmon—Coho salmon (N=11,324) passed through the weir between July 20 and September 9. Gillnet marks (N=261) were observed on 2% of the coho salmon passing the weir. Peak weekly passage (N=8,759) was between August 21 and August 27 (Figure 2). The median cumulative passage date occurred on August 25 (Appendix 2).

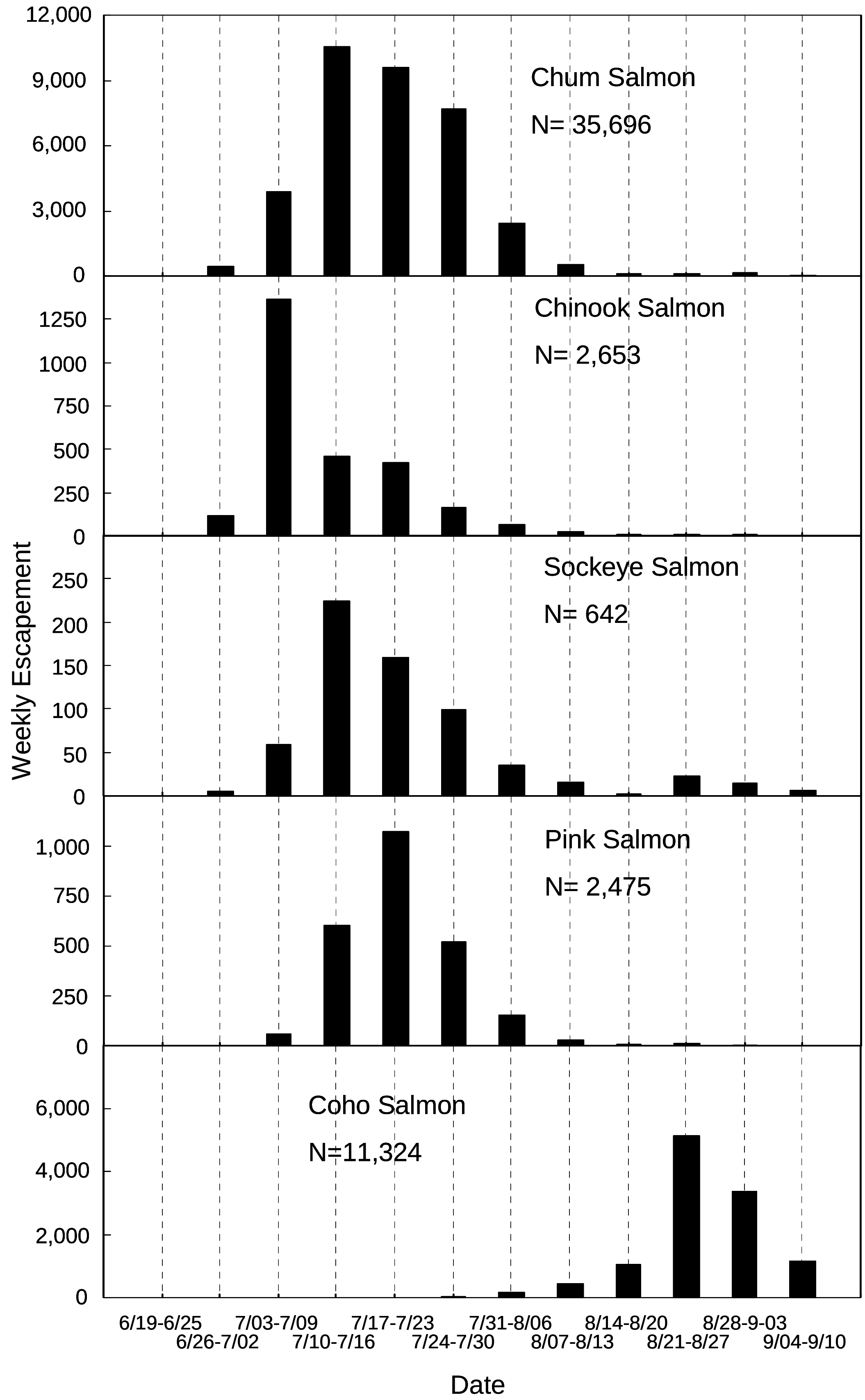


FIGURE 2.—Weekly chum, Chinook, sockeye, pink, and coho salmon escapements through the Tuluksak River weir, Alaska, 2005.

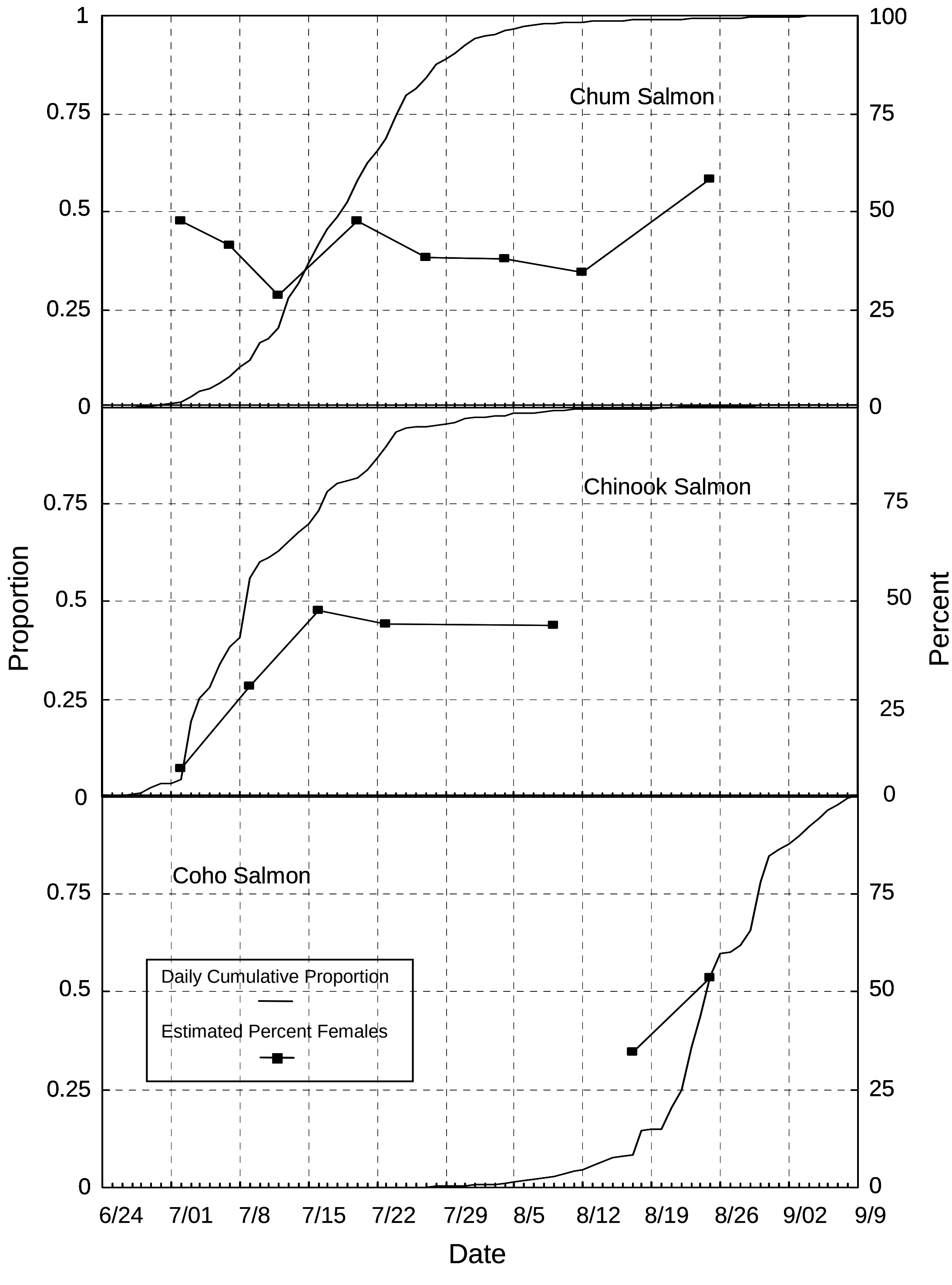


FIGURE 3.—Cumulative proportion and percent females of chum, Chinook, and coho salmon through the Tuluksak River weir, Alaska, 2005.

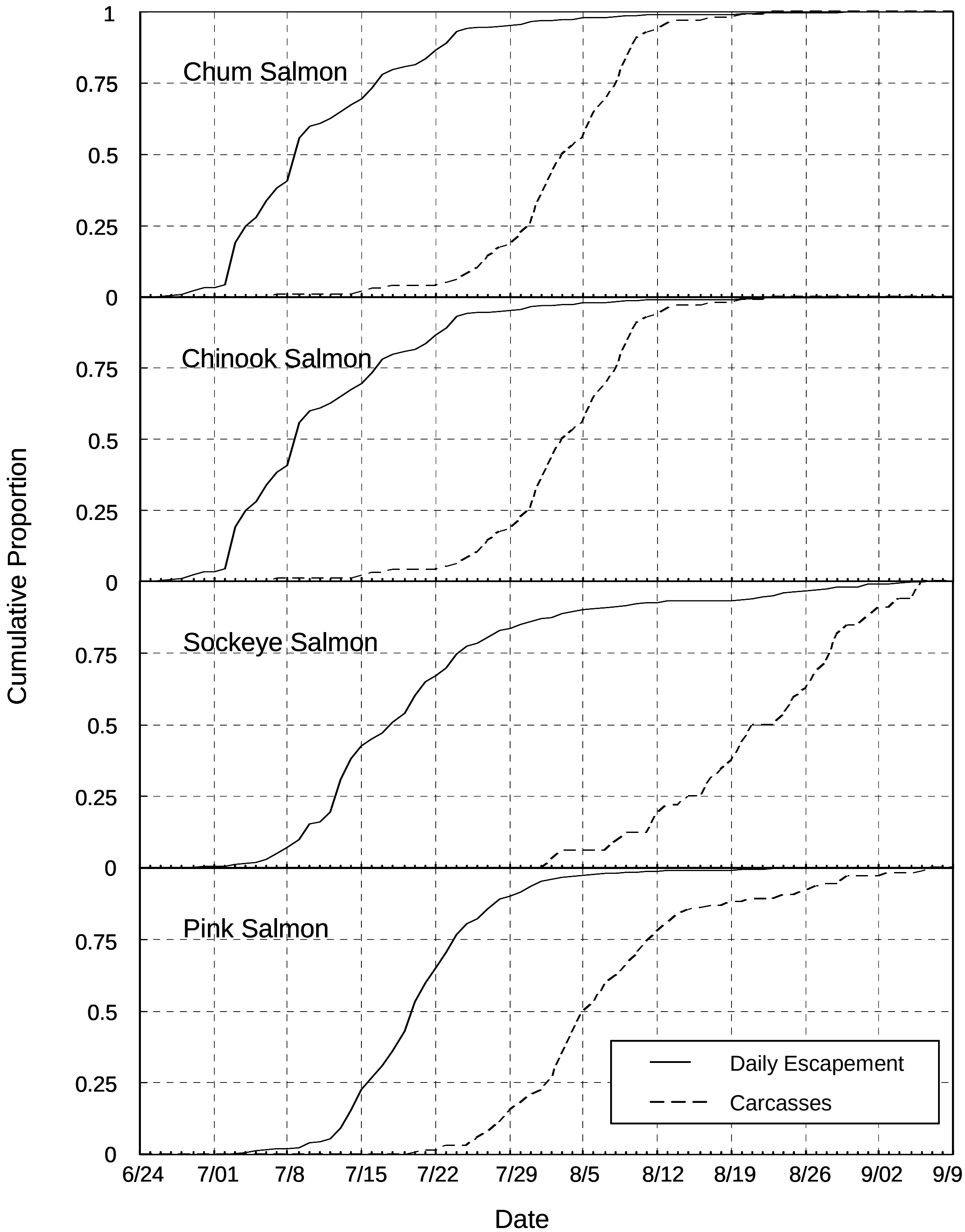


FIGURE 4.—Cumulative proportion of daily chum, Chinook, and coho salmon passage and carcasses washing onto the upstream side of the Tuluksak River weir, Alaska, 2005.

Three age classes were identified from 360 sampled coho salmon. The majority (90%) of the coho salmon were age 2.1 (Appendix 7). The remaining sample was comprised of age 3.1 (7%) and 1.1 (3%) fish. Females composed 51% of the coho salmon escapement (Figure 3; Appendix 7). Age composition did not differ between sexes for age 2.1 ($P>0.05$). Mean lengths were not significantly different ($P>0.05$) for age 2.1 (564 mm) males and (567 mm) females (Appendix 8). Insufficient age and length composition data were available for age 1.1 and 3.1 (Appendix 8).

The first coho salmon carcass was recorded on August 4, 2005. By September 9, 2005, when the weir was removed, only 5 coho salmon carcasses were passed.

Resident Species—Resident species counted through the weir consisted of 52 Dolly Varden, 94 whitefish, five northern pike, and 21 Arctic grayling. Although smaller sized resident species were able to pass freely through the pickets, passage through the passage chutes was recorded throughout the entire season. A total of one Dolly Varden, eight whitefish, two northern pike, and one Arctic grayling carcass were recorded on the weir.

Discussion

Weir Operations

The weir was operated from June 24 through September 9, 2005. Installation was facilitated by low water depths during early June. Low water conditions persisted until August 20. August and September rains brought the water level up substantially to flood stage September 1. The decision to pull the weir one day early was made due to water levels that continued to rise during the three prior days.

The weir was removed on September 9, 2005 and the substrate rail and cable were left in place to expedite installation in 2006.

Biological Data

Chum Salmon—The 2005 escapement of 35,696 was 146% of the 2001 chum salmon escapement (N=19,321), which was the highest escapement on record (Gates and Harper 2002). Past escapements have ranged between 7,675 and 19,321 with an average of 11,695 (Figure 5).

Other escapement projects located on Kuskokwim River tributaries indicate the 2005 chum salmon escapement was above the recorded average. The sonar project on the Aniak River, achieved the sustainable escapement goal for the fourth year in a row and the sonar count was the highest on record since 1981. (D. Molyneaux, ADF&G, Bethel, personal communication). Both the Tatlawiksuk and Takotna River chum salmon escapements were the highest on record (D. Costello, ADF&G, Anchorage, unpublished data).

The median passage date for chum salmon occurred on July 19, two days earlier than the historical average of July 21 (Gates and Harper 2003; Zabkar and Harper 2004). Similar to 2004 the early arrival may have been influenced by the low water conditions. The 2002 water level was the next lowest on record and chum salmon also returned with an early median passage date of July 17 (Gates and Harper 2003).

Males dominated the escapement (61%) and in all weekly passage estimates except the last sample in August where females made up the majority (Figure 3, Appendix 3). Females also made up less than 50% of the return in 2003, 2004. The low percent females results from an increase of age 0.3 chum salmon, which was heavily dominated by males. Similar to recent years the percent female for chum salmon has been less than 50%, ranging from 33 to 44% from 2001 to 2005 (Gates and Harper 2002, 2003; Zabkar and Harper 2004). This differs from the early years of operation, from 1991 to 1994 where the percent female was 48 to 52% (Harper 1995a, 1995b, 1995c, 1997). Likewise, the dominating age group was age 0.3, and in the early 90's females dominated males, however in recent years of operation, the males have dominated age 0.3, and caused the total percent female to shift below 50% of the run.

Age 0.3 chum salmon comprised 93% of the return in 2005, an increase in that age over previous years. Males and females of age 0.2 represented only 1% and 3% of the total escapement while age 0.4 represented <3% of the return. The high percentage of age 0.3 chum salmon were from the 2001 brood year, which was the highest escapement on record until this year. As a result we have seen high sibling returns of age 0.2 during 2004, and high returns of age 0.3 during 2005 (Gates and Harper 2003; Zabkar and Harper 2004).

From 1991-1994, and 2002-2004, the difference between median cumulative passage dates for upstream migrants and downstream carcass passage at the weir ranged from 7 to 15 days. During all years, the median cumulative passage dates for carcasses occurred between July 19 and August 8 (Harper 1997; Gates and Harper 2002, 2003; Zabkar and Harper 2004).

Gill net marks (N=156) were observed on <1% of the chum salmon passing the weir, similar to 2003 and 2004, which also returned <1% gill net marked chum salmon observed at the weir (Harper 1995a, 1995b, 1995c, 1997; Gates and Harper 2002, 2003; Zabkar and Harper 2004).

Gill net marks were more frequently observed during years when a commercial harvest of chum salmon occurred in late June and early July, as confirmed in 1991 and 1992 (5% and 4%, respectively) when commercial fishing occurred. Commercial fishing did occur between June 24 and July 1, and Chinook, chum, and sockeye salmon were harvested. The commercial fishing periods did not appear to influence the amount of gill net marks observed at the weir (<1%).

Chinook Salmon—The Chinook salmon count during 2005 (N=2,653) was the second highest escapement on record, and above of the historical average (N=1,543) (Figure 5). Run timing in 2005 was early; the median passage date occurred two days before the average (Appendix 2). Chinook salmon median passage dates for all six years of weir operation are between July 5 and July 14 (Gates and Harper 2003; Zabkar and Harper 2004).

In previous years, Tuluksak River Chinook salmon returns were dominated by age 1.2, 1.3 and 1.4 fish, with age 1.3 the most prevalent. Similarly, the dominant age groups in 2005 were age 1.2, 1.3, and 1.4, representing 31%, 33%, and 35% of the total escapement. The returns of age 1.4 in 2005 was the highest proportion of that age on record (Harper 1995a, 1995b, 1995c, 1997; Gates and Harper 2002, 2003; Zabkar and Harper 2004). If the return of siblings holds, there should be a high return of age 1.5 Chinook in 2006.

Due to the increase of age 1.4 fish that returned in 2005, the total percentage of Chinook salmon females (35%) during 2005 was one of the highest on record. Females in previous years (1991-1994 and 2002-2004) have represented between 14% and 37%, and an average of 21% of the annual returns (Harper 1995a, 1995b, 1995c, 1997; Gates and Harper 2002, 2003; Zabkar and Harper 2004).

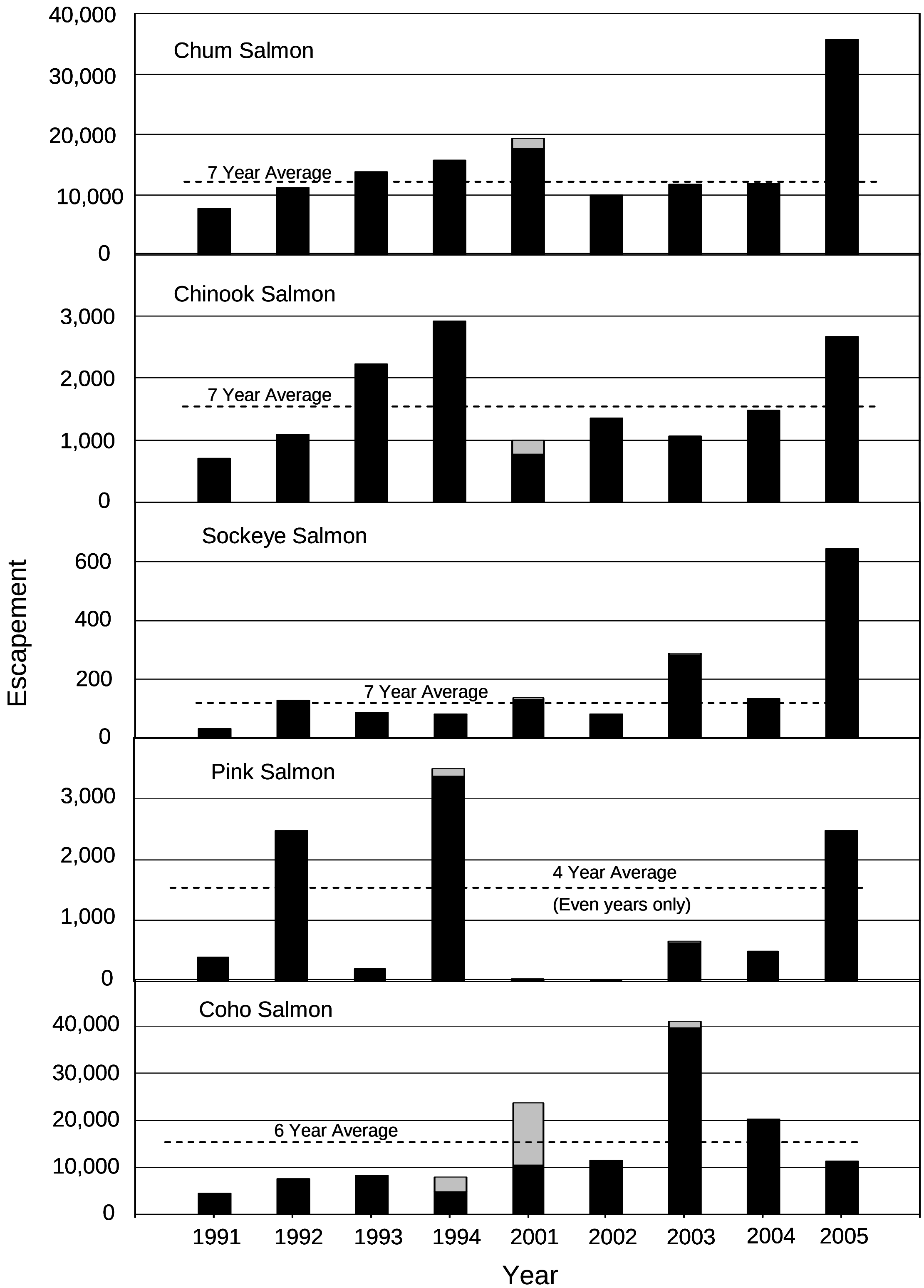


FIGURE 5.—Salmon escapements through the Tuluksak River weir, Alaska, 1991-1994, and 2001-2005. Note shading for estimated counts. Averages were calculated using only years with complete counts. The y-axis uses different scales.

The original classification of small fish as females was thought to be erroneous and a misidentification of sex. For example in the first strata the percent of age 1.2 females was extraordinarily high at 31%. The percent of age 1.2 females in the first strata from 1991 through 1994 were 3.3%, 4.5%, 0.5%, and 5.2% respectively and between 2002 and 2004 0.0%, 0.0%, and 5.4% respectively. This is compared to the percentages of age 1.2 in the annual subsistence catches from the Kuskokwim River between 2002 and 2005 which were 1.6%, 0.4%, 0.1% and 0.2% respectively (ADF&G 2006). Age 1.2 females is also low at other weir projects such as the Kogrukluk River weir, where they comprised only 0.3% of the escapement (ADF&G 2006). A similar problem of small Chinook salmon identified as females occurred on the George River in 1996 and 1997 when sex ratios and ages were compared with sex and age data of sex-confirmed fish from the commercial fishery in the lower Kuskokwim River (DuBois and Molyneaux 2000). George River ASL data was subsequently revised and small females (<700 mm) were reclassified as males (Linderman et al. 2003).

To establish the validity of the original classification, a sub sample of fish was analyzed using the *OtY1* genetic marker (Chowen and Nagler 2004; Olsen et al. 2004). All fish analyzed had a strong male genetic signature, which was used as justification to reclassify the sex of the fish in the sample that were smaller than 700 mm. The reclassification of the smaller Chinook salmon from females to males lowered the total percent females in the first stratum to 0.0% and the annual return of females from 40% to 35%. It is important to note, however, that *OtY1* has incorrectly identified some females as males in some populations (Chowen and Nagler 2005). This error appears to be populations specific and it is unlikely that such error would account for all 15 instances of discordant phenotypic and genetic sex. Nevertheless, additional tests using the *OtY1* marker and known sex fish (visual confirmation of gonads) from the Tuluksak River is warranted. Additional personnel training in phenotypic identification will be undertaken in the future.

Similar to 2003 and 2004 the 2005 subsistence-fishing schedule maintained windows of fishing opportunity. These four-day windows of fishing and three days of closure were designed to allow for an adequate subsistence harvest and improve the quality of spawning escapement. According to test fish indices and subsistence harvest reports, Chinook and chum salmon were arriving average to early, and in strong numbers; therefore, on June 19, managers opened the subsistence-fishing schedule to seven days per week. The schedule was rescinded one day earlier than in 2004. The strong return of Chinook and chum salmon allowed many Kuskokwim River tributaries to meet their escapement goals and subsistence users were able to harvest an adequate number of fish. The initial commercial fishing periods occurred between June 24 and July 1 and harvested Chinook, chum and sockeye salmon (C. Whitmore, ADF&G, Anchorage, unpublished data).

Other escapement monitoring projects also confirmed that Kuskokwim River Chinook salmon returned in large numbers. Kogrukluk River weir was 21,993, which exceeded the 5,300 – 14,000 Chinook salmon escapement goal. This is the highest Chinook salmon escapement for Kogrukluk River weir on record (J. Jasper, ADF&G, unpublished data). Similarly the Talawiksuk River Chinook salmon was the highest on record (D. Costello, ADF&G, Anchorage, unpublished data).

Aerial surveys of Tuluksak River have been conducted by the Department sporadically since 1965 (Harper 1997; Ward et al. 2003). Optimal time for the Tuluksak River Chinook salmon aerial survey is late July. This period coincides with more than 90% of upstream passage through the weir, and less than 10% of the carcasses passing downstream. During 2005, an aerial survey, conducted on July 28, estimated 672 Chinook salmon, which was 27% of the total escapement to date (J. Linderman, ADF&G, Bethel, personal communication). At the time of the 2005 aerial survey, 23% of the Chinook carcasses had passed down over the weir. An aerial survey goal for Tuluksak River Chinook salmon has not been established due a "lack of sufficient historical escapement and stock contribution data" (ADF&G 2004).

From 1991-1994, and 2002-2005, the difference between median cumulative passage dates for upstream migrants and downstream carcass passage at the weir ranged from 21 to 33 days. During all years, the median cumulative passage dates for carcasses occurred between August 2 and August 8 (Harper 1997; Gates and Harper 2002, 2003; Zabkar and Harper 2004).

Gill net marks (N=34) were observed on 1% of the Chinook salmon passing the weir. Historically gill net marks have ranged from 1 to 10% (Harper 1995a, 1995b, 1995c, 1997; Gates and Harper 2002, 2003; Zabkar and Harper 2004). Similar to chum salmon, a higher percentage of gill net marks are typically present during years with commercial fishing periods occurring late June and early July (1991 and 1992; 10%) (Harper 1997). Commercial fishing began on June 24 on the Kuskokwim River and only 4,787 Chinook salmon were commercially harvested (J Linderman ADF&G, Bethel, personal communication). Observed gill net marks at the weir remained similar to those years without a fishery.

Sockeye Salmon—The total number of sockeye salmon passing the Tuluksak River weir has been consistently small (N<150). In 2005, the sockeye salmon escapement (N=642) was the highest escapement on record (Figure 5). Similarly, other escapement projects located on the Kuskokwim River tributaries had strong sockeye salmon returns. The sockeye salmon returns to the Kogrukluk, Tatlawiksuk, and Takotna River weirs were the highest on record (J. Jasper, ADF&G, Anchorage unpublished data, D. Costello, ADF&G, Anchorage, unpublished data).. Similarly, the George River weir had the highest sockeye salmon escapement on record since 1997 (R. Stewart, ADF&G, Anchorage, unpublished data).

Fifty percent had passed the weir by July 18, four days after the earliest median passage date on record. Median passage dates have previously ranged between July 14 and August 1 (1991-1994, 2001 - 2004) (Gates and Harper 2003; Zabkar and Harper 2004).

Since only a small population of sockeye salmon return to the Tuluksak River, there were no samples collected for age and length analysis.

Currently, sockeye are not actively managed in the lower Kuskokwim River commercial fishing districts from the mouth of the Kuskokwim River up to the village of Tuluksak (Ward et al. 2003). The 2005 commercial catch was greater than the recent 10-year average harvest of sockeye salmon (C. Whitmore, ADF&G, Anchorage, unpublished data).

Pink Salmon—Kuskokwim River pink salmon typically have strong even-year runs (Francisco et al. 1992). This was observed between 1991 and 1994 where even years averaged 2,979 and odd years averaged 301 individuals (Figure 5). In 2005, the estimated pink salmon escapement (N=2,475) returned in greater strength than the odd year average escapements (N=422), and stronger than the even year average escapements (N=1,620). Pink salmon escapements during previous years of operation have ranged from 27 to 3,374 fish (1991-1994, and 2001-2004). The median passage of July 20 was the second earliest date on record, next to July 14, 2002 (Harper 1995b, 1997; Gates and Harper 2003). Currently, no pink salmon escapement goals have been established and very little is known about the Kuskokwim River pink salmon stocks.

Coho Salmon—The 2005 coho salmon escapement was approximately 73% of the historical average. This return was below the past four years of escapement on the Tuluksak River (Figure 5). Similarly, average to below average returns occurred in other Kuskokwim tributaries during 2005. The George, Tatlawiksuk, and Takotna rivers coho salmon return were all below historical averages. Kogrukluk River coho salmon return was within the escapement goal range, but below 2003 and 2004 (D. Costello, ADF&G, Anchorage, unpublished data. J. Jasper, ADF&G, Anchorage, unpublished data. R. Stewart, ADF&G, Anchorage, unpublished data; C. Whitmore, ADF&G, Anchorage, unpublished data).

Run timing in 2005 was early compared to all previous years of weir operations. The median passage date for coho salmon was August 25, three days before the August 28 average (Appendix 2). The range of previous year's median passage dates were August 19 to September 5 (Gates and Harper 2003; Zabkar and Harper 2004).

Similar to past years, age 2.1 was the dominate age group for 2005, representing an estimated 90% of the escapement. Ages 1.1 and 3.1 were present in the escapement. Age 2.1 has been the primary age group in all years of operations. Females age 2.1 in 2005 made up 47% of the escapement, resulting in a high percentage of total females (51%) in the escapement. The range of percent females in previous years was 32% to 58% (Harper 1995a, 1995b, 1995c, 1997; Gates and Harper 2002, 2003; Zabkar and Harper 2004).

The percentage of gill net marks in the 2005 weir escapement was 2% compared to previous years; 2 - 9% (Harper 1995a, 1995c; Gates and Harper 2003; Zabkar and Harper 2004). Coho escapements for 1994 and 2001 were estimated; therefore the recorded gill net marks for these years is not an accurate representation. The number of gill net marks has decreased with the decrease of commercial fishing time and harvest of coho salmon. During 2005, lower coho salmon run strength to the Kuskokwim River resulted in a reduction in the quantity and length of commercial fishing periods (J. Linderman, ADF&G, Bethel, personal communication).

Coho salmon carcasses were first recorded on August 5, 2005 and 5 coho salmon carcasses were passed over the weir by September 9, 2005. This historically is one of the lowest carcass count of coho salmon observed on the Tuluksak River (Zabkar and Harper 2004). Carcass counts observed from 1991 to 1994, and 2001 - 2004 ranged from 2 to 28 coho salmon (Harper 1997; Gates and Harper 2002, 2003).

Acknowledgements

The U.S. Fish and Wildlife Service, Office of Subsistence Management provided funding through the Fisheries Resource Monitoring Program under the contract 701814C125 (FIS 04-302), between U.S. Fish and Wildlife Service, Office of Subsistence Management, and Tuluksak IRA Council.

The success of this project hinged on the cooperation between all parties involved. We would like to thank Tuluksak Native Community (TNC), especially Moses Peters, for their cooperation and project support. TNC technicians Johnny Owens, Patric Gregory, and Nick Lott all provided assistance with weir operations. Special appreciation is extended to Kenai Fish and Wildlife Field Office staff. We are very indebted to Anne Barrett for her administrative support throughout the entire year. In addition, special thanks is extended to the U.S. Fish and Wildlife Service crew leader Brittany Blain and Melissa Gamber, a U.S. Fish and Wildlife volunteer intern, for their endless efforts in project setup, operation and removal of the weir and to Jason Montoya for his help on the weir.

We also appreciate the assistance that Doug Molyneaux, Doug Bue, and staff, Alaska Department and Fish and Game, Commercial Fisheries Division, Kuskokwim Area, provided us throughout the season. Scale analysis was made possible by a grant from the U.S. Fish and Wildlife Service, Office of Subsistence Management, Resource Monitoring Program agreement #FIS 01-117, which supported salmon age-sex-length aging and data analysis.

References

Agresti, A. 1990. Categorical Data Analysis. John Wiley & Sons. New York.

ADF&G (Alaska Department of Fish and Game) 2004. Escapement goal review of select AYK region salmon stocks. Alaska Department of Fish and Game, Division of Commercial Fisheries of the Kuskokwim Area, Regional Information Report[1] No. 3A04-01, Anchorage, Alaska.

ADF&G. Kuskokwim ASL Catalog (Tables Only) - Updated 2005. Available: http://www.cf.adfg.state.ak.us/region3/ pubs/kuskokwim/05kskasltbls.pdf, (April 2006)

Bergstrom, D. J., and C. Whitmore. 2004. Kuskokwim River Chinook and chum salmon stock status and action plan, a report to the Alaska Board of Fisheries. Alaska Department of Fish and Game, Commercial Fisheries Division, Regional Information Report 3A04-02, Anchorage.

Chowen, T.R., and J.J. Nagler. 2004. Temporal and spatial occurrence of female Chinook salmon carrying a male-specific genetic marker in the Columbia River watershed. Environmental Biology of Fishes 69:427-432.

Chowen, T.R., and J.J. Nagler. 2005. Lack of sex specificity for growth hormone pseudogene in fall-run Chinook salmon from the Columbia River. Transactions of the American Fisheries Society. 134:279-282

Cochran, W.G. 1977. Sampling techniques, 3rd edition. John Wiley and Sons, New York.

DuBois, L., and D. B. Molyneaux 2000. Salmon age, sex and length catalog for the Kuskokwim Area, 1999 Progress Report. Alaska Department of Fish and Game, Division of Commercial Fisheries, AYK Region, Regional Information Report 3A00-18.Anchorage.

Devlin, R. H., B. K. McNeil, T. D. D. Groves, and E. M. Donaldson. 1991. Isolation of a Y-chromosomal DNA probe capable of determining genetic sex in Chinook salmon (*Oncorhynchus tshawytscha*). Canadian Journal of Fisheries and Aquatic Sciences. 48:1606-1612.

Francisco, K. R., C. Anderson, C. Burkey, M. Coffing, K. Hyer, D. Molyneaux, and C. Utermohle. 1992. Annual management report for the subsistence and commercial fishery of the Kuskokwim Area, 1991. Alaska Department of Fish and Game, Division of Commercial Fisheries, AYK Region, Regional Information Report 3A92-06, Anchorage, Alaska.

Gates, K. S., and K. C. Harper. 2002. Abundance and run timing of adult Pacific salmon in the Tuluksak River, Yukon Delta National Wildlife Refuge, Alaska, 2001. U.S. Fish and Wildlife Service, Kenai Fish and Wildlife Field Office. Alaska Fisheries Data Series Number 2002-6, Kenai, Alaska.

Gates, K. S., and K. C. Harper. 2003. Abundance and run timing of adult Pacific salmon in the Tuluksak River, Yukon Delta National Wildlife Refuge, Alaska, 2002. U.S. Fish and Wildlife Service, Kenai Fish and Wildlife Field Office. Alaska Fisheries Data Series Number 2003-1, Kenai, Alaska.

Geiger, J. H., J. E. Clark, B. Cross, and S. McPherson. 1990. Report from the work group on sampling. Pages 3-12 *in* H.J. Geiger, and R.L. Wilbur, editors. Proceedings of the 1990 Alaska stock separation workshop. Alaska Department of Fish and Game, Division of Commercial Fisheries, Special Fisheries Report No. 2, Juneau, Alaska.

Harper, K. C. 1995a. Run timing and abundance of adult salmon in the Tuluksak River, Yukon Delta National Wildlife Refuge, Alaska, 1991. U.S. Fish and Wildlife Service, Kenai Fishery Resource Office, Alaska Fisheries Progress Report, 95-1, Kenai, Alaska.

Harper, K. C. 1995b. Run timing and abundance of adult salmon in the Tuluksak River, Yukon Delta National Wildlife Refuge, Alaska, 1992. U.S. Fish and Wildlife Service, Kenai Fishery Resource Office, Alaska Fisheries Progress Report, 95-3, Kenai, Alaska.

Harper, K. C. 1995c. Run timing and abundance of adult salmon in the Tuluksak River, Yukon Delta National Wildlife Refuge, Alaska, 1993. U.S. Fish and Wildlife Service, Kenai Fishery Resource Office, Alaska Fisheries Progress Report, 95-2, Kenai, Alaska.

Harper, K. C. 1997. Run timing and abundance of adult salmon in the Tuluksak River, Yukon Delta National Wildlife Refuge, Alaska, 1994. U.S. Fish and Wildlife Service, Kenai Fishery Resource Office, Alaska Fisheries Technical Report 41, Anchorage, Alaska.

Koo, T. S. Y. 1962. Age determination in salmon. Pages 37-48 *in* T.S.Y. Koo, editor. Studies of Alaskan red salmon. University of Washington Press, Seattle, Washington.

Linderman, J. C., D. B. Molyneaux, L. Dubois, and D. J. Cannon. 2003. George River salmon studies, 1996-2002. Alaska Department of Fish and Game, Division of Commercial Fisheries, AYK Region, Regional Information Report, 3A03-17, Anchorage, Alaska.

Mosher, K. H. 1968. Photographic atlas of sockeye salmon scales. U.S. Fish and Wildlife Service, Bureau of Commercial Fisheries, Fishery Bulletin No. 2: 243-274.

Metcalf V.J., and N.J. Gemmel. 2006. Sexual genotype markers absent from small numbers of male New Zealand Onchorynchus tshawytscha. Journal of Fish Biology (2006) 68 (Supplement A), 136-143.

Nagler, J. J., T. Cavileer, K. Stienhorst, and R. H. Deviln. 2004. Determination of genetic sex in chinook salmon (*Oncorhynchus tshawytscha*) using the male-linked growth hormone pseudogene by real-time PCR. Mar. Biotechnol. 6:186-191.

Olsen, J. B., S. J. Miller, K. Harper, J. J. Nagler, K. Van Hatten, K. Whitton, and J. K. Wenburg. 2004. Sex ratios of juvenile and adult chinook salmon in the Kuskokwim and Yukon Rivers. U.S. Fish and Wildlife Service, Office of Subsistence Management, Fisheries Resource Monitoring Program, Final Report for Study 02-097, Anchorage, Alaska

Rao, J. N. K., and D. R. Thomas. 1989. Chi-squared tests for contingency tables. Pages 89-114 *in* Skinner, C.J., D. Holt, and T.M.F. Smith, editors. Analysis of complex surveys. John Wiley & Sons, New York.

Seber, G. A. F. 1982. The estimation of animal abundance and related parameters, 2nd edition. Maxmillan, New York.

Systat 8 Statistics. SPSS Inc. Chicago, IL, USA.

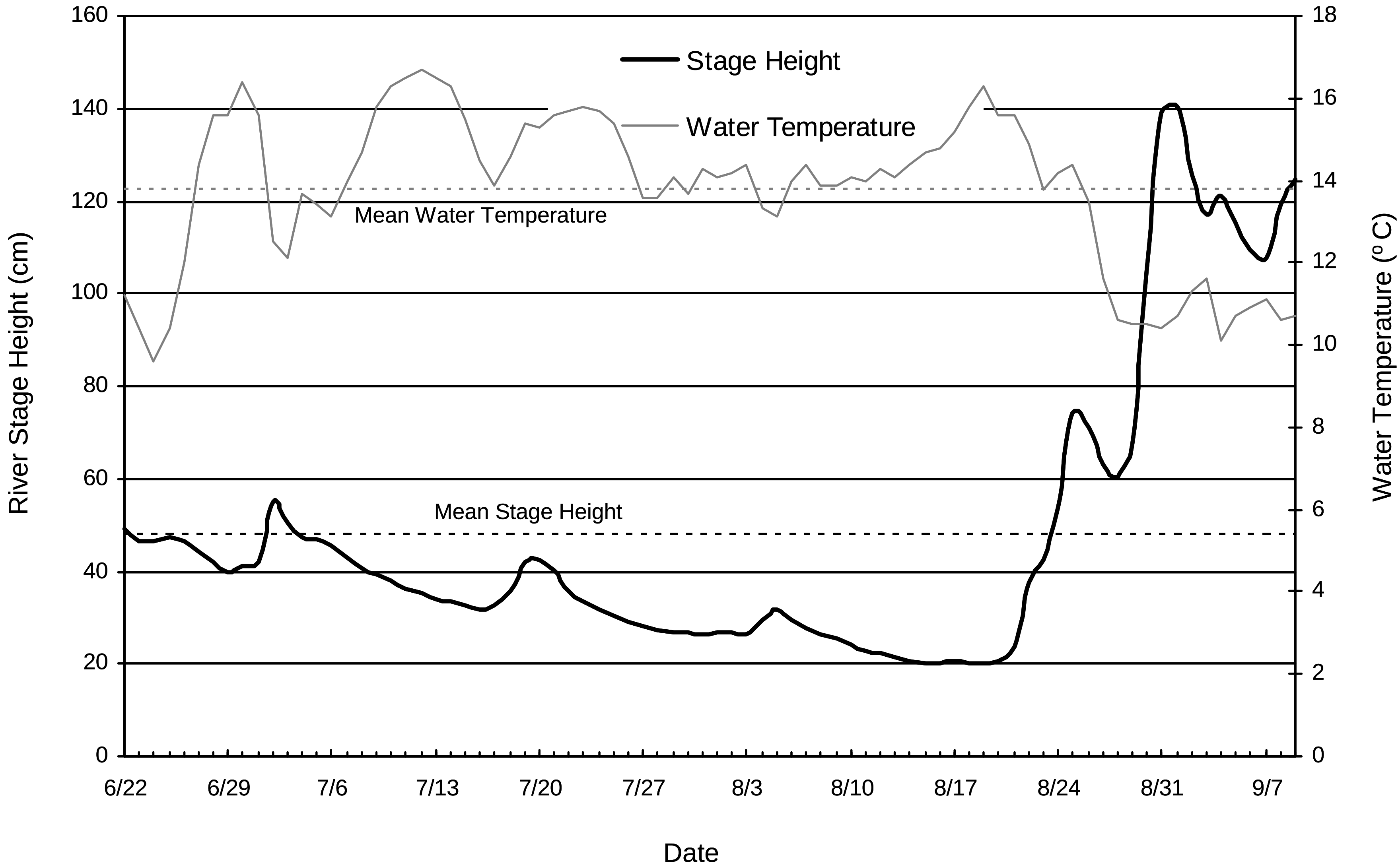
Tobin, J. H. 1994. Construction and performance of a portable resistance board weir for counting migrating adult salmon in rivers. U.S. Fish and Wildlife Service, Kenai Fishery Resource Office. Alaska Fisheries Technical Report Number 22. Kenai, Alaska.

U.S. Fish and Wildlife Service. 1992. Fishery management plan for the Yukon Delta National Wildlife Refuge. U.S. Fish and Wildlife Service, Anchorage, Alaska.

Ward, T. C., M. Coffing, J. Estenson, R. Fisher, and D. Molyneaux. 2003. Annual management report for the subsistence and commercial fisheries of the Kuskokwim Area, 2002. Alaska Department of Fish and Game, Division of Commercial Fisheries, Regional Information Report 3A03-27, Anchorage, Alaska.

Whitmore, C., M. Martz, D. G. Bue and J. C. Linderman, and R. Fisher 2005. Annual fishery management report for the subsistence and commercial fisheries of the Kuskokwim area 2003. Alaska Department of Fish and Game, Fisheries Management Report No. 05-72, Anchorage.

Zabkar, L. M., and K. C. Harper. 2004. Abundance and run timing of adult Pacific salmon in the Tuluksak River, Yukon Delta National Wildlife Refuge, Alaska, 2003. U.S. Fish and Wildlife Service, Kenai Fish and Wildlife Field Office. Alaska Fisheries Data Series Number 2004-6, Kenai, Alaska.



APPENDIX 1.—River stage heights and water temperatures at the Tuluksak River weir, 2005.

APPENDIX 2.—Daily, cumulative, and cumulative proportion of chum, Chinook, sockeye, pink, and coho salmon passing through the Tuluksak River weir, Alaska, 2005.

	Chum Salmon			Chinook Salmon			Sockeye Salmon			Pink Salmon			Coho Salmon		
	Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative	
	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion
06/22															
06/23															
06/24	0	0	0.0000	0	0	0.0000	0	0	0.0000	0	0	0.0000	0	0	0.0000
06/25	0	0	0.0000	0	0	0.0000	0	0	0.0000	0	0	0.0000	0	0	0.0000
06/26	0	0	0.0000	5	5	0.0019	0	0	0.0000	0	0	0.0000	0	0	0.0000
06/27	38	38	0.0011	14	19	0.0072	2	2	0.0031	0	0	0.0000	0	0	0.0000
06/28	43	81	0.0023	7	26	0.0098	0	2	0.0031	0	0	0.0000	0	0	0.0000
06/29	82	163	0.0046	40	66	0.0249	1	3	0.0047	1	1	0.0004	0	0	0.0000
06/30	136	299	0.0084	25	91	0.0343	1	4	0.0062	1	2	0.0008	0	0	0.0000
07/01	33	332	0.0093	3	94	0.0354	0	4	0.0062	0	2	0.0008	0	0	0.0000
07/02	128	460	0.0129	24	118	0.0445	1	5	0.0078	0	2	0.0008	0	0	0.0000
07/03	552	1,012	0.0284	393	511	0.1926	4	9	0.0140	3	5	0.0020	0	0	0.0000
07/04	463	1,475	0.0413	154	665	0.2507	2	11	0.0171	14	19	0.0077	0	0	0.0000
07/05	327	1,802	0.0505	79	744	0.2804	2	13	0.0202	13	32	0.0129	0	0	0.0000
07/06	406	2,208	0.0619	152	896	0.3377	7	20	0.0312	11	43	0.0174	0	0	0.0000
07/07	642	2,850	0.0798	122	1,018	0.3837	12	32	0.0498	4	47	0.0190	0	0	0.0000
07/08	838	3,688	0.1033	60	1,078	0.4063	15	47	0.0732	7	54	0.0218	0	0	0.0000
07/09	674	4,362	0.1222	405	1,483	0.5590	17	64	0.0997	9	63	0.0255	0	0	0.0000
07/10	1,476	5,838	0.1635	109	1,592	0.6001	34	98	0.1526	42	105	0.0424	0	0	0.0000
07/11	486	6,324	0.1772	29	1,621	0.6110	5	103	0.1604	8	113	0.0457	0	0	0.0000
07/12	882	7,206	0.2019	46	1,667	0.6283	23	126	0.1963	23	136	0.0549	0	0	0.0000
07/13	2,797	10,003	0.2802	63	1,730	0.6521	73	199	0.3100	97	233	0.0941	0	0	0.0000
07/14	1,299	11,302	0.3166	63	1,793	0.6758	46	245	0.3816	150	383	0.1547	0	0	0.0000
07/15	1,838	13,140	0.3681	52	1,845	0.6954	29	274	0.4268	178	561	0.2267	0	0	0.0000
07/16	1,761	14,901	0.4174	97	1,942	0.7320	14	288	0.4486	104	665	0.2687	0	0	0.0000
07/17	1,381	16,282	0.4561	130	2,072	0.7810	14	302	0.4704	102	767	0.3099	0	0	0.0000
07/18	1,089	17,371	0.4866	47	2,119	0.7987	25	327	0.5093	124	891	0.3600	0	0	0.0000
07/19	1,381	18,752	0.5253	22	2,141	0.8070	20	347	0.5405	174	1,065	0.4303	0	0	0.0000
07/20	1,909	20,661	0.5788	22	2,163	0.8153	40	387	0.6028	252	1,317	0.5321	2	2	0.0002
07/21	1,645	22,306	0.6249	51	2,214	0.8345	29	416	0.6480	166	1,483	0.5992	5	7	0.0006
07/22	1,078	23,384	0.6551	82	2,296	0.8654	15	431	0.6713	127	1,610	0.6505	1	8	0.0007
07/23	1,136	24,520	0.6869	70	2,366	0.8918	16	447	0.6963	130	1,740	0.7030	0	8	0.0007
07/24	2,090	26,610	0.7455	101	2,467	0.9299	31	478	0.7445	159	1,899	0.7673	0	8	0.0007
07/25	1,797	28,407	0.7958	32	2,499	0.9420	18	496	0.7726	94	1,993	0.8053	0	8	0.0007

-continued-

APPENDIX 2.—(Page 2 of 3)

	Chum Salmon			Chinook Salmon			Sockeye Salmon			Pink Salmon			Coho Salmon		
	Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative	
	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion
07/26	693	29,100	0.8152	8	2,507	0.9450	8	504	0.7850	41	2,034	0.8218	0	8	0.0007
07/27	975	30,075	0.8425	1	2,508	0.9453	12	516	0.8037	83	2,117	0.8554	1	9	0.0008
07/28	1,177	31,252	0.8755	13	2,521	0.9502	15	531	0.8271	84	2,201	0.8893	8	17	0.0015
07/29	460	31,712	0.8884	3	2,524	0.9514	6	537	0.8364	28	2,229	0.9006	2	19	0.0017
07/30	486	32,198	0.9020	7	2,531	0.9540	9	546	0.8505	31	2,260	0.9131	5	24	0.0021
07/31	804	33,002	0.9245	34	2,565	0.9668	6	552	0.8598	56	2,316	0.9358	14	38	0.0034
08/01	646	33,648	0.9426	4	2,569	0.9683	6	558	0.8692	39	2,355	0.9515	29	67	0.0059
08/02	221	33,869	0.9488	5	2,574	0.9702	3	561	0.8738	16	2,371	0.9580	13	80	0.0071
08/03	163	34,032	0.9534	9	2,583	0.9736	7	568	0.8847	18	2,389	0.9653	11	91	0.0080
08/04	273	34,305	0.9610	1	2,584	0.9740	5	573	0.8925	9	2,398	0.9689	32	123	0.0109
08/05	175	34,480	0.9659	10	2,594	0.9778	5	578	0.9003	11	2,409	0.9733	42	165	0.0146
08/06	180	34,660	0.9710	5	2,599	0.9796	3	581	0.9050	7	2,416	0.9762	23	188	0.0166
08/07	147	34,807	0.9751	4	2,603	0.9812	2	583	0.9081	10	2,426	0.9802	36	224	0.0198
08/08	116	34,923	0.9783	3	2,606	0.9823	1	584	0.9097	1	2,427	0.9806	42	266	0.0235
08/09	76	34,999	0.9805	8	2,614	0.9853	2	586	0.9128	5	2,432	0.9826	50	316	0.0279
08/10	47	35,046	0.9818	5	2,619	0.9872	5	591	0.9206	4	2,436	0.9842	65	381	0.0336
08/11	56	35,102	0.9834	4	2,623	0.9887	2	593	0.9237	1	2,437	0.9846	67	448	0.0396
08/12	18	35,120	0.9839	1	2,624	0.9891	1	594	0.9252	3	2,440	0.9859	58	506	0.0447
08/13	67	35,187	0.9857	0	2,624	0.9891	3	597	0.9299	5	2,445	0.9879	122	628	0.0555
08/14	21	35,208	0.9863	1	2,625	0.9894	1	598	0.9315	5	2,450	0.9899	123	751	0.0663
08/15	23	35,231	0.9870	1	2,626	0.9898	0	598	0.9315	1	2,451	0.9903	105	856	0.0756
08/16	17	35,248	0.9874	0	2,626	0.9898	0	598	0.9315	0	2,451	0.9903	32	888	0.0784
08/17	15	35,263	0.9879	1	2,627	0.9902	0	598	0.9315	1	2,452	0.9907	49	937	0.0827
08/18	27	35,290	0.9886	2	2,629	0.9910	0	598	0.9315	0	2,452	0.9907	691	1,628	0.1438
08/19	11	35,301	0.9889	1	2,630	0.9913	0	598	0.9315	0	2,452	0.9907	39	1,667	0.1472
08/20	17	35,318	0.9894	3	2,633	0.9925	1	599	0.9330	2	2,454	0.9915	20	1,687	0.1490
08/21	31	35,349	0.9903	5	2,638	0.9943	3	602	0.9377	4	2,458	0.9931	634	2,321	0.2050
08/22	31	35,380	0.9911	2	2,640	0.9951	5	607	0.9455	1	2,459	0.9935	503	2,824	0.2494
08/23	17	35,397	0.9916	2	2,642	0.9959	3	610	0.9502	3	2,462	0.9947	1,251	4,075	0.3599
08/24	9	35,406	0.9919	0	2,642	0.9959	5	615	0.9579	6	2,468	0.9972	840	4,915	0.4340
08/25	12	35,418	0.9922	0	2,642	0.9959	2	617	0.9611	0	2,468	0.9972	1,166	6,081	0.5370
08/26	15	35,433	0.9926	0	2,642	0.9959	3	620	0.9657	1	2,469	0.9976	671	6,752	0.5963
08/27	18	35,451	0.9931	0	2,642	0.9959	2	622	0.9688	0	2,469	0.9976	58	6,810	0.6014
08/28	24	35,475	0.9938	1	2,643	0.9962	3	625	0.9735	0	2,469	0.9976	181	6,991	0.6174

-continued-

APPENDIX 2.—(Page 3 of 3)

	Chum Salmon			Chinook Salmon			Sockeye Salmon			Pink Salmon			Coho Salmon		
	Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative		Daily	Cumulative	
	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion	Count	Count	Proportion
08/29	42	35,517	0.9950	2	2,645	0.9970	3	628	0.9782	2	2,471	0.9984	411	7,402	0.6537
08/30	45	35,562	0.9962	5	2,650	0.9989	2	630	0.9813	1	2,472	0.9988	1,444	8,846	0.7812
08/31 *	30	35,592	0.9971	1	2,651	0.9992	0	630	0.9813	0	2,472	0.9988	728	9,574	0.8455
09/01 *	10	35,602	0.9974	0	2,651	0.9992	4	634	0.9875	0	2,472	0.9988	195	9,769	0.8627
09/02 *	13	35,615	0.9977	2	2,653	1.0000	2	636	0.9907	2	2,474	0.9996	164	9,933	0.8772
09/03 *	20	35,635	0.9983	0	2,653	1.0000	0	636	0.9907	0	2,474	0.9996	235	10,168	0.8979
09/04 *	11	35,646	0.9986	0	2,653	1.0000	2	638	0.9938	1	2,475	1.0000	256	10,424	0.9205
09/05 *	21	35,667	0.9992	0	2,653	1.0000	1	639	0.9953	0	2,475	1.0000	249	10,673	0.9425
09/06 *	14	35,681	0.9996	0	2,653	1.0000	2	641	0.9984	0	2,475	1.0000	226	10,899	0.9625
09/07 *	7	35,688	0.9998	0	2,653	1.0000	1	642	1.0000	0	2,475	1.0000	155	11,054	0.9762
09/08 *	5	35,693	0.9999	0	2,653	1.0000	0	642	1.0000	0	2,475	1.0000	196	11,250	0.9935
09/09 *	3	35,696	1.0000	0	2,653	1.0000	0	642	1.0000	0	2,475	1.0000	74	11,324	1.0000
09/10															

* Partial counts due to high water.

APPENDIX 3.—Estimated age and sex composition of weekly chum salmon escapements through the Tuluksak River weir, Alaska, 2005, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group					
		2002	2001	2000	1999	1998	
		0.2	0.3	0.4	0.5	0.6	Total
Stratum 1:	06/26 - 07/02						
Sampling Dates:	06/27 - 06/29 & 07/02						
Male:	Number in Sample:	1	55	12	3	0	71
	Estimated % of Escapement:	0.7	39.6	8.6	2.2	0.0	51.1
	Estimated Escapement:	3	182	40	10	0	235
	Standard Error:	2.8	16.0	9.2	4.8	0.0	
Female:	Number in Sample:	0	62	5	1	0	68
	Estimated % of Escapement:	0.0	44.6	3.6	0.7	0.0	48.9
	Estimated Escapement:	0	205	17	3	0	225
	Standard Error:	0.0	16.3	6.1	2.8	0.0	
Total:	Number in Sample:	1	117	17	4	0	139
	Estimated % of Escapement:	0.7	84.2	12.2	2.9	0.0	100.0
	Estimated Escapement:	3	387	56	13	0	460
	Standard Error:	2.8	11.9	10.7	5.5	0.0	
Stratum 2:	07/03 - 07/09						
Sampling Dates:	07/04 - 07/07						
Male:	Number in Sample:	0	103	3	0	0	106
	Estimated % of Escapement:	0.0	56.0	1.6	0.0	0.0	57.6
	Estimated Escapement:	0	2,184	64	0	0	2,248
	Standard Error:	0.0	139.8	35.7	0.0	0.0	
Female:	Number in Sample:	2	71	4	1	0	78
	Estimated % of Escapement:	1.1	38.6	2.2	0.5	0.0	42.4
	Estimated Escapement:	42	1,506	85	21	0	1,654
	Standard Error:	29.2	137.1	41.1	20.7	0.0	
Total:	Number in Sample:	2	174	7	1	0	184
	Estimated % of Escapement:	1.1	94.6	3.8	0.5	0.0	100.0
	Estimated Escapement:	42	3,690	148	21	0	3,902
	Standard Error:	29.2	63.8	53.9	20.7	0.0	
Stratum 3:	07/10 - 07/16						
Sampling Dates:	07/11 & 07/12						
Male:	Number in Sample:	1	121	5	1	0	128
	Estimated % of Escapement:	0.6	68.8	2.8	0.6	0.0	72.7
	Estimated Escapement:	60	7,246	299	60	0	7,665
	Standard Error:	59.4	366.2	131.2	59.4	0.0	
Female:	Number in Sample:	4	44	0	0	0	48
	Estimated % of Escapement:	2.3	25.0	0.0	0.0	0.0	27.3
	Estimated Escapement:	240	2,635	0	0	0	2,874
	Standard Error:	117.7	342.1	0.0	0.0	0.0	
Total:	Number in Sample:	5	165	5	1	0	176
	Estimated % of Escapement:	2.8	93.8	2.8	0.6	0.0	100.0
	Estimated Escapement:	299	9,880	299	60	0	10,539
	Standard Error:	131.2	191.2	131.2	59.4	0.0	

APPENDIX 3.—(Page 2 of 3)

		Brood Year and Age Group					
		2002	2001	2000	1999	1998	
		0.2	0.3	0.4	0.5	0.6	Total
Stratum 4:	07/17 - 07/23						
Sampling Dates:	07/19 & 07/20						
Male:	Number in Sample:	1	85	4	0	0	90
	Estimated % of Escapement:	0.6	48.0	2.3	0.0	0.0	50.8
	Estimated Escapement:	54	4,619	217	0	0	4,891
	Standard Error:	53.8	358.9	106.8	0.0	0.0	
Female:	Number in Sample:	5	82	0	0	0	87
	Estimated % of Escapement:	2.8	46.3	0.0	0.0	0.0	49.2
	Estimated Escapement:	272	4,456	0	0	0	4,728
	Standard Error:	119.0	358.2	0.0	0.0	0.0	
Total:	Number in Sample:	6	167	4	0	0	177
	Estimated % of Escapement:	3.4	94.4	2.3	0.0	0.0	100.0
	Estimated Escapement:	326	9,076	217	0	0	9,619
	Standard Error:	130.0	165.9	106.8	0.0	0.0	
Stratum 5:	07/24 - 07/30						
Sampling Dates:	07/26 & 07/27						
Male:	Number in Sample:	3	111	3	0	0	117
	Estimated % of Escapement:	1.5	56.9	1.5	0.0	0.0	60.0
	Estimated Escapement:	118	4,371	118	0	0	4,607
	Standard Error:	67.0	269.5	67.0	0.0	0.0	
Female:	Number in Sample:	9	69	0	0	0	78
	Estimated % of Escapement:	4.6	35.4	0.0	0.0	0.0	40.0
	Estimated Escapement:	354	2,717	0	0	0	3,071
	Standard Error:	114.2	260.2	0.0	0.0	0.0	
Total:	Number in Sample:	12	180	3	0	0	195
	Estimated % of Escapement:	6.2	92.3	1.5	0.0	0.0	100.0
	Estimated Escapement:	472	7,087	118	0	0	7,678
	Standard Error:	130.8	145.0	67.0	0.0	0.0	
Stratum 6:	07/31 - 08/06						
Sampling Dates:	08/02 - 08/04						
Male:	Number in Sample:	4	97	3	0	0	104
	Estimated % of Escapement:	2.4	57.7	1.8	0.0	0.0	61.9
	Estimated Escapement:	59	1,422	44	0	0	1,524
	Standard Error:	28.0	90.8	24.4	0.0	0.0	
Female:	Number in Sample:	8	56	0	0	0	64
	Estimated % of Escapement:	4.8	33.3	0.0	0.0	0.0	38.1
	Estimated Escapement:	117	821	0	0	0	938
	Standard Error:	39.2	86.7	0.0	0.0	0.0	
Total:	Number in Sample:	12	153	3	0	0	168
	Estimated % of Escapement:	7.1	91.1	1.8	0.0	0.0	100.0
	Estimated Escapement:	176	2,242	44	0	0	2,462
	Standard Error:	47.4	52.4	24.4	0.0	0.0	

APPENDIX 3.—(Page 3 of 3)

		Brood Year and Age Group					
		2002	2001	2000	1999	1998	
		0.2	0.3	0.4	0.5	0.6	Total
Stratum 7:	08/07 - 08/13						
Sampling Dates:	08/09 - 08/12						
Male:	Number in Sample:	1	45	0	0	0	46
	Estimated % of Escapement:	1.4	63.4	0.0	0.0	0.0	64.8
	Estimated Escapement:	7	334	0	0	0	341
	Standard Error:	6.9	28.2	0.0	0.0	0.0	
Female:	Number in Sample:	8	17	0	0	0	25
	Estimated % of Escapement:	11.3	23.9	0.0	0.0	0.0	35.2
	Estimated Escapement:	59	126	0	0	0	186
	Standard Error:	18.5	25.0	0.0	0.0	0.0	
Total:	Number in Sample:	9	62	0	0	0	71
	Estimated % of Escapement:	12.7	87.3	0.0	0.0	0.0	100.0
	Estimated Escapement:	67	460	0	0	0	527
	Standard Error:	19.5	19.5	0.0	0.0	0.0	
Strata 8 & 9:	08/14 - 08/27						
Sampling Dates:	08/14 - 08/25						
Male:	Number in Sample:	1	14	0	0	0	15
	Estimated % of Escapement:	2.7	37.8	0.0	0.0	0.0	40.5
	Estimated Escapement:	7	100	0	0	0	107
	Standard Error:	6.6	19.8	0.0	0.0	0.0	
Female:	Number in Sample:	4	17	1	0	0	22
	Estimated % of Escapement:	10.8	45.9	2.7	0.0	0.0	59.5
	Estimated Escapement:	29	121	7	0	0	157
	Standard Error:	12.7	20.3	6.6	0.0	0.0	
Total:	Number in Sample:	5	31	1	0	0	37
	Estimated % of Escapement:	13.5	83.8	2.7	0.0	0.0	100.0
	Estimated Escapement:	36	221	7	0	0	264
	Standard Error:	13.9	15.0	6.6	0.0	0.0	
Strata 10 & 11:	08/28 - 09/09						
No Samples Collected							
Strata 1 - 9:	06/26 - 09/09						
Sampling Dates:	06/27 - 08/25						
Male:	Number in Sample:	12	631	30	4	0	677
	% Males in Age Group:	1.4	94.6	3.6	0.3	0.0	100.0
	Estimated % of Escapement:	0.9	57.7	2.2	0.2	0.0	61.0
	Estimated Escapement:	309	20,457	782	70	0	21,618
	Standard Error:	108.6	603.9	187.2	59.6	0.0	
	Estimated Design Effects:	1.278	1.394	1.514	1.679	0.000	1.383
Female:	Number in Sample:	40	418	10	2	0	470
	% Females in Age Group:	8.0	91.0	0.8	0.2	0.0	100.0
	Estimated % of Escapement:	3.1	35.5	0.3	0.1	0.0	39.0
	Estimated Escapement:	1,113	12,587	109	25	0	13,833
	Standard Error:	209.7	583.7	42.0	20.9	0.0	
	Estimated Design Effects:	1.350	1.388	0.560	0.608	0.000	1.383
Total:	Number in Sample:	52	1,049	40	6	0	1,147
	Estimated % of Escapement:	4.0	93.2	2.5	0.3	0.0	100.0
	Estimated Escapement:	1,422	33,044	891	94	0	35,451 *
	Standard Error:	234.3	304.4	191.7	63.1	0.0	
	Estimated Design Effects:	1.332	1.368	1.401	1.401	0.000	

* 245 fish that were counted through the weir during strata 10 and 11 are not included in this total.

APPENDIX 4.—Estimated length at age composition of weekly chum salmon escapements through the Tuluksak River weir, Alaska, 2005

		Brood Year and Age Group				
		2002	2001	2000	1999	1998
		2.0	3.0	4.0	5.0	6.0
Stratum 1:	06/26 - 07/02					
Sampling Dates:	06/27 - 06/29 & 07/02					
Male:	Mean Length	515	583	613	607	
	Std. Error		4	9	12	
	Range	515- 515	510- 650	570- 660	595- 630	
	Sample Size	1	55	12	3	0
Female:	Mean Length		555	571	540	
	Std. Error		3	12		
	Range		510- 640	540- 600	540- 540	
	Sample Size	0	62	5	1	0
Stratum 2:	07/03 - 07/09					
Sampling Dates:	07/04 - 07/07					
Male:	Mean Length		595	635		
	Std. Error		3	33		
	Range		525- 650	575- 690		
	Sample Size	0	103	3	0	0
Female:	Mean Length	500	565	588	580	
	Std. Error	5	3	13		
	Range	495- 505	490- 630	550- 610	580- 580	
	Sample Size	2	71	4	1	0
Stratum 3:	07/10 - 07/16					
Sampling Dates:	07/11 & 07/12					
Male:	Mean Length	520	584	600	590	
	Std. Error		3	8		
	Range	520- 520	510- 675	575- 620	590- 590	
	Sample Size	1	121	5	1	0
Female:	Mean Length	524	562			
	Std. Error	2	5			
	Range	520- 530	500- 620			
	Sample Size	4	44	0	0	0
Stratum 4:	07/17 - 07/23					
Sampling Dates:	07/19 & 07/20					
Male:	Mean Length	510	577	570		
	Std. Error		3	8		
	Range	510- 510	525- 695	555- 590		
	Sample Size	1	85	4	0	0
Female:	Mean Length	533	552			
	Std. Error	8	3			
	Range	515- 555	475- 620			
	Sample Size	5	82	0	0	0
Stratum 5:	07/24 - 07/30					
Sampling Dates:	07/26 & 07/27					
Male:	Mean Length	522	565	608		
	Std. Error	14	3	25		
	Range	495- 540	475- 670	560- 640		
	Sample Size	3	111	3	0	0
Female:	Mean Length	513	535			
	Std. Error	9	4			
	Range	465- 555	470- 600			
	Sample Size	9	69	0	0	0

APPENDIX 4.—(Page 2 of 2)

		Brood Year and Age Group				
		2002	2001	2000	1999	1998
		2.0	3.0	4.0	5.0	6.0
Stratum 6:	07/31 - 08/06					
Sampling Dates:	08/02 - 08/04					
Male:	Mean Length	519	562	590		
	Std. Error	9	3	20		
	Range	500- 540	445- 640	570- 630		
	Sample Size	4	97	3	0	0
Female:	Mean Length	504	524			
	Std. Error	8	5			
	Range	460- 540	435- 610			
	Sample Size	8	56	0	0	0
Stratum 7:	08/07 - 08/13					
Sampling Dates:	08/09 - 08/12					
Male:	Mean Length	530	558			
	Std. Error		5			
	Range	530- 530	485- 640			
	Sample Size	1	45	0	0	0
Female:	Mean Length	516	524			
	Std. Error	11	8			
	Range	465- 565	470- 595			
	Sample Size	8	17	0	0	0
Strata 8 & 9:	08/14 - 08/27					
Sampling Dates:	08/14 - 08/25					
Male:	Mean Length	515	563			
	Std. Error		7			
	Range	515- 515	520- 600			
	Sample Size	1	14	0	0	0
Female:	Mean Length	498	524	560		
	Std. Error	21	8			
	Range	455- 550	460- 590	560- 560		
	Sample Size	4	17	1	0	0
Strata 10 & 11:	08/28 - 09/09					
No Samples Collected						
Strata 1 - 11:	06/26 - 09/09					
Sampling Dates:	06/27 - 08/27					
Male:	Mean Length	519	577	596	592	
	Std. Error	10	1	6	12	
	Range	495- 540	445- 695	555- 690	590- 630	
	Sample Size	12	631	30	4	0
Female:	Mean Length	518	550	583	575	
	Std. Error	4	2	11		
	Range	455- 565	435- 640	540- 610	540- 580	
	Sample Size	40	418	10	2	0

APPENDIX 5.—Estimated age and sex composition of weekly Chinook salmon escapements through the Tuluksak River weir, Alaska, 2005, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group					
		2002	2001	2000	1999	1998	
		1.1	1.2	1.3	1.4	1.5	Total
Stratum 1:	06/26 - 07/02						
Sampling Dates:	06/27 - 06/29 and 07/02						
Male:	Number in Sample:	0	38	10	3	0	51
	Estimated % of Escapement:	0.0	69.1	18.2	5.5	0.0	92.7
	Estimated Escapement:	0	82	21	6	0	109
	Standard Error:	0.0	5.4	4.5	2.7	0.0	
Female:	Number in Sample:	0	0	1	3	0	4
	Estimated % of Escapement:	0.0	0.0	1.8	5.5	0.0	7.3
	Estimated Escapement:	0	0	2	6	0	9
	Standard Error:	0.0	0.0	1.6	2.7	0.0	
Total:	Number in Sample:	0	38	11	6	0	55
	Estimated % of Escapement:	0.0	69.1	20.0	10.9	0.0	100.0
	Estimated Escapement:	0	82	24	13	0	118
	Standard Error:	0.0	5.4	4.7	3.7	0.0	
Stratum 2:	07/03 - 07/09						
Sampling Dates:	07/04 - 07/09						
Male:	Number in Sample:	0	70	43	24	0	137
	Estimated % of Escapement:	0.0	36.6	22.5	12.6	0.0	71.7
	Estimated Escapement:	0	500	307	172	0	979
	Standard Error:	0.0	44.3	38.4	30.4	0.0	
Female:	Number in Sample:	0	0	12	42	0	54
	Estimated % of Escapement:	0.0	0.0	6.3	22.0	0.0	28.3
	Estimated Escapement:	0	0	86	300	0	386
	Standard Error:	0.0	0.0	22.3	38.0	0.0	
Total:	Number in Sample:	0	70	55	66	0	191
	Estimated % of Escapement:	0.0	36.6	28.8	34.6	0.0	100.0
	Estimated Escapement:	0	500	393	472	0	1,365
	Standard Error:	0.0	44.3	41.6	43.7	0.0	
Stratum 3:	07/10 - 07/16						
Sampling Dates:	07/12 - 07/16						
Male:	Number in Sample:	0	14	20	11	0	45
	Estimated % of Escapement:	0.0	16.3	23.3	12.8	0.0	52.3
	Estimated Escapement:	0	75	107	59	0	240
	Standard Error:	0.0	16.6	19.0	15.0	0.0	
Female:	Number in Sample:	0	0	10	30	1	41
	Estimated % of Escapement:	0.0	0.0	11.6	34.9	1.2	47.7
	Estimated Escapement:	0	0	53	160	5	219
	Standard Error:	0.0	0.0	14.4	21.4	4.8	
Total:	Number in Sample:	0	14	30	41	1	86
	Estimated % of Escapement:	0.0	16.3	34.9	47.7	1.2	100.0
	Estimated Escapement:	0	75	160	219	5	459
	Standard Error:	0.0	16.6	21.4	22.4	4.8	

APPENDIX 5.—(Page 2 of 2)

		Brood Year and Age Group					
		2002	2001	2000	1999	1998	
		1.1	1.2	1.3	1.4	1.5	Total
Stratum 4:	07/17 - 07/23						
Sampling Dates:	07/19 & 07/23						
Male:	Number in Sample:	0	16	19	6	1	42
	Estimated % of Escapement:	0.0	21.3	25.3	8.0	1.3	56.0
	Estimated Escapement:	0	90	107	34	6	237
	Standard Error:	0.0	18.3	19.4	12.1	5.1	
Female:	Number in Sample:	0	0	15	17	1	33
	Estimated % of Escapement:	0.0	0.0	20.0	22.7	1.3	44.0
	Estimated Escapement:	0	0	85	96	6	187
	Standard Error:	0.0	0.0	17.9	18.7	5.1	
Total:	Number in Sample:	0	16	34	23	2	75
	Estimated % of Escapement:	0.0	21.3	45.3	30.7	2.7	100.0
	Estimated Escapement:	0	90	192	130	11	424
	Standard Error:	0.0	18.3	22.3	20.6	7.2	
Strata 5, 6 & 7:	07/24 - 08/13						
Sampling Dates:	07/26 & 08/09						
Male:	Number in Sample:	0	8	8	2	0	18
	Estimated % of Escapement:	0.0	25.0	25.0	6.3	0.0	56.3
	Estimated Escapement:	0	65	65	16	0	145
	Standard Error:	0.0	18.8	18.8	10.5	0.0	
Female:	Number in Sample:	0	0	5	9	0	14
	Estimated % of Escapement:	0.0	0.0	15.6	28.1	0.0	43.8
	Estimated Escapement:	0	0	40	73	0	113
	Standard Error:	0.0	0.0	15.7	19.5	0.0	
Total:	Number in Sample:	0	8	13	11	0	32
	Estimated % of Escapement:	0.0	25.0	40.6	34.4	0.0	100.0
	Estimated Escapement:	0	65	105	89	0	258
	Standard Error:	0.0	18.8	21.3	20.6	0.0	
Strata 8 - 11:	08/14 - 09/09						
No Samples Collected							
Strata 1 - 11:	06/26 - 09/09						
Sampling Dates:	06/27 - 08/09						
Male:	Number in Sample:	0	146	100	46	1	293
	% Males in Age Group:	0.0	47.4	35.5	16.8	0.3	100.0
	Estimated % of Escapement:	0.0	30.9	23.1	10.9	0.2	65.2
	Estimated Escapement:	0	811	607	287	6	1,711
	Standard Error:	0.0	54.3	50.8	37.6	5.1	
	Estimated Design Effects:	0.000	1.036	1.092	1.093	0.946	1.052
Female:	Number in Sample:	0	0	43	101	2	146
	% Females in Age Group:	0.0	0.0	29.2	69.6	1.2	100.0
	Estimated % of Escapement:	0.0	0.0	10.2	24.2	0.4	34.8
	Estimated Escapement:	0	0	266	635	11	913
	Standard Error:	0.0	0.0	35.7	51.4	7.0	
	Estimated Design Effects:	0.000	0.000	1.052	1.081	0.922	1.052
Total:	Number in Sample:	0	146	143	147	3	439
	Estimated % of Escapement:	0.0	30.9	33.3	35.1	0.6	100.0
	Estimated Escapement:	0	811	874	922	17	2,624
	Standard Error:	0.0	54.3	56.2	57.2	8.7	
	Estimated Design Effects:	0.000	1.036	1.07	1.078	0.924	

* 29 fish that were counted through the weir during stratum 8 - 10 are not included in this total.

APPENDIX 6.—Estimated length at age composition of weekly Chinook salmon escapements through the Tuluksak River weir, Alaska, 2005.

		Brood Year and Age Group				
		2002	2001	2000	1999	1998
		1.1	1.2	1.3	1.4	1.5
Stratum 1:	06/26 - 07/02					
Sampling Dates:	06/27 - 06/29 & 07/02					
Male:	Mean Length		554	690	768	
	Std. Error		9	14	35	
	Range		450- 695	615- 770	710- 830	
	Sample Size	0	38	10	3	0
Female:	Mean Length			705	780	
	Std. Error				38	
	Range			705- 705	705- 820	
	Sample Size	0	0	1	3	0
Stratum 2:	07/03 - 07/09					
Sampling Dates:	07/04 - 07/09					
Male:	Mean Length		551	672	800	
	Std. Error		6	10	18	
	Range		400- 685	515- 820	640-1020	
	Sample Size	0	70	43	24	0
Female:	Mean Length			797	848	
	Std. Error			11	7	
	Range			725- 860	770- 970	
	Sample Size	0	0	12	42	0
Stratum 3:	07/10 - 07/16					
Sampling Dates:	07/11 - 07/16					
Male:	Mean Length		574	684	777	
	Std. Error					
	Range		490- 680	560- 755	640- 880	
	Sample Size	0	14	20	11	0
Female:	Mean Length			766	825	870
	Std. Error			8	11	
	Range			710- 790	730- 960	870- 870
	Sample Size	0	0	10	30	1
Stratum 4:	07/17 - 07/23					
Sampling Dates:	07/19 - 07/23					
Male:	Mean Length		574	681	718	820
	Std. Error					
	Range		450- 660	500- 755	660- 775	820- 820
	Sample Size	0	16	19	6	1
Female:	Mean Length			772	818	790
	Std. Error			6	10	
	Range			720- 810	740- 895	790- 790
	Sample Size	0	0	15	17	1

APPENDIX 6.—(Page 2 of 2)

		Brood Year and Age Group				
		2002	2001	2000	1999	1998
		1.1	1.2	1.3	1.4	1.5
Strata 5, 6, & 7:	07/24 - 08/13					
Sampling Dates:	07/26 - 08/09					
Male:	Mean Length		554	686	760	
	Std. Error					
	Range		480- 625	620- 750	700- 820	
	Sample Size	0	8	8	2	0
Female:	Mean Length			764	832	
	Std. Error			17	23	
	Range			720- 810	710- 925	
	Sample Size	0	0	5	9	0
Strata 8 - 11:	08/14 - 09/09					
No Samples Collected						
Strata 1 - 11:	06/26 - 09/09					
Sampling Dates:	06/27 - 08/09					
Male:	Mean Length		551	674	799	
	Std. Error		6	9	18	
	Range		400- 695	500- 820	640-1020	820- 820
	Sample Size	0	146	100	46	1
Female:	Mean Length			795	847	
	Std. Error			11	7	
	Range			705- 860	705- 970	790- 870
	Sample Size	0	0	43	101	2

APPENDIX 7.—Estimated age and sex composition of weekly coho salmon escapements through the Tuluksak River weir, Alaska, 2005, and estimated design effects of the stratified sampling design.

		Brood Year and Age Group				
		2002	2001	2000	1999	
		1.1	2.1	3.1	4.1	Total
Strata 1 - 7:	06/26 - 08/13					
No Samples Collected						
Stratum 8:	08/14 - 08/20					
Sampling Dates:	08/14 - 08/20					
Male:	Number in Sample:	3	104	15	0	122
	Estimated % of Escapement:	1.6	56.5	8.2	0.0	66.3
	Estimated Escapement:	17	599	86	0	702
	Standard Error:	9.0	35.3	19.5	0.0	
Female:	Number in Sample:	0	59	3	0	62
	Estimated % of Escapement:	0.0	32.1	1.6	0.0	33.7
	Estimated Escapement:	0	340	17	0	357
	Standard Error:	0.0	33.2	9.0	0.0	
Total:	Number in Sample:	3	163	18	0	184
	Estimated % of Escapement:	1.6	88.6	9.8	0.0	100.0
	Estimated Escapement:	17	938	104	0	1,059
	Standard Error:	9.0	22.6	21.1	0.0	
Stratum 9:	08/21 - 09/03					
Sampling Dates:	08/21 - 08/27					
Male:	Number in Sample:	2	72	5	0	79
	Estimated % of Escapement:	1.1	40.9	2.8	0.0	44.9
	Estimated Escapement:	58	2,096	146	0	2,300
	Standard Error:	40.3	187.1	63.2	0.0	
Female:	Number in Sample:	4	87	6	0	97
	Estimated % of Escapement:	2.3	49.4	3.4	0.0	55.1
	Estimated Escapement:	116	2,532	175	0	2,823
	Standard Error:	56.7	190.3	69.1	0.0	
Total:	Number in Sample:	6	159	11	0	176
	Estimated % of Escapement:	3.4	90.3	6.3	0.0	100.0
	Estimated Escapement:	175	4,628	320	0	5,123
	Standard Error:	69.1	112.4	92.1	0.0	
Strata 10 & 11:	08/28 - 09/09					
No Samples Collected						
Strata 1 - 11:	06/26 - 09/09					
Sampling Dates:	08/14 - 08/27					
Male:	Number in Sample:	5	176	20	0	201
	% Males in Age Group:	2.5	89.8	7.7	0.0	100.0
	Estimated % of Escapement:	1.2	43.6	3.8	0.0	48.6
	Estimated Escapement:	75	2,694	232	0	3,002
	Standard Error:	41.3	190.4	66.2	0.0	
	Estimated Design Effects:	1.389	1.443	1.197	0.000	1.447
Female:	Number in Sample:	4	146	9	0	159
	% Females in Age Group:	3.7	90.3	6.0	0.0	100.0
	Estimated % of Escapement:	1.9	46.5	3.1	0.0	51.4
	Estimated Escapement:	116	2,872	192	0	3,180
	Standard Error:	56.7	193.1	69.6	0.0	
	Estimated Design Effects:	1.693	1.466	1.573	0.000	1.447
Total:	Number in Sample:	9	322	29	0	360
	Estimated % of Escapement:	3.1	90.0	6.9	0.0	100.0
	Estimated Escapement:	192	5,566	424	0	6,182 *
	Standard Error:	69.6	114.7	94.5	0.0	
	Estimated Design Effects:	1.573	1.436	1.372	0.000	

* 5,142 fish that were counted through the weir during strata 1 - 7, 10 and 11 are not included in this total.

APPENDIX 8.—Estimated length at age composition of weekly coho salmon escapements through the Tuluksak River weir, Alaska, 2005.

		Brood Year and Age Group		
		2002	2001	2000
		1.1	2.1	3.1
Strata 1 - 7:				
No Samples Collected				
Stratum 8:	08/14 - 08/20			
Sampling Dates:	08/14 - 08/17			
Male:	Mean Length	538	552	595
	Std. Error	16	5	10
	Range	510- 565	385- 660	500- 660
	Sample Size	3	104	15
Female:	Mean Length		564	565
	Std. Error		4	17
	Range		440- 630	535- 595
	Sample Size	0	59	3
Stratum 9:	08/21 - 08/27			
Sampling Dates:	08/24 & 08/25			
Male:	Mean Length	550	567	591
	Std. Error		5	9
	Range	550- 550	440- 650	570- 620
	Sample Size	2	72	5
Female:	Mean Length	558	568	574
	Std. Error	19	4	14
	Range	520- 600	450- 625	530- 615
	Sample Size	4	87	6
Strata 8 & 9:	08/14 - 08/27			
Sampling Dates:	08/14 - 08/25			
Male:	Mean Length	547	564	592
	Std. Error	4	4	7
	Range	510- 565	385- 660	500- 660
	Sample Size	5	176	20
Female:	Mean Length	558	567	573
	Std. Error	19	3	13
	Range	520- 600	440- 630	530- 615
	Sample Size	4	146	9
Strata 10 & 11:	08/28 - 09/09			
No Samples Collected				